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THE SCAR OF LOW OR CERVICAL CESAREAN SECTION

A CLINICAL, HISTOLOGICAL STUDY

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THE low or cervical cesarean section has received increasingly favorable consideration during the last fifteen years. One of the claims for this operation has been a stronger and better scar and a lower incidence of rupture in subsequent pregnancies and labors. Wetterwald[1] found that up to that time 3600 cervical cesarean sections had been reported in the literature with an incidence of rupture of 0.28 per cent. J. P. Greenhill and B. Bloom[2] reported that as far as they knew not a single patient on whom a cervical cesarean section (731 operations) had been performed at the Chicago Lying-In Hospital had had a rupture of the uterus in a subsequent pregnancy and labor. In April, 1931, I reported 418 consecutive cervical cesarean sections performed by myself.[3] There were in this group 105 repeated operations. One hundred one scars were solidly healed and could not be identified as such by the naked eye. Four scars were defective, three of them were very thin and the fourth, which had been extended in the uterine body for a voluminous fetus, was solid in its cervical part but thinned out for an area 2.5 × 2.5 cm. in its corporeal portion. There were no ruptured scars in this series of 418 cases and 11 women had 14 pelvic deliveries. Four of my patients who had cervical cesarean sections subsequently had hysterectomies, so that their cervices were available for histological study. The cases of these four women form the basis of this paper.

[1] *Zentralbl. f. Gynäk.*, March 6, 1926.
[2] *J. A. M. A.*, Jan. 5, 1929.
[3] *Am. J. Obst. & Gynec.*, April, 1931.

CASE 1. *History.* Mrs. M. M. G., thirty-six years of age, was admitted to the Gynecological and Obstetrical Service of the Carney Hospital four times. No abnormalities were discovered in her family and past histories. Menstruation was established when she was fourteen years of age; her periods were regular, of the twenty-eight day type; they lasted two days and were painless. She had had three pregnancies. She had first been admitted to the Service after having been in labor for three days. The baby was dead in utero on admission. She was delivered by version and extraction and a craniotomy on the after-coming head on March 13, 1923. The placenta, which was adherent, was extracted manually. The puerperium was complicated by cystitis and pyelitis, a rise in temperature from 103.4°F. to 102.6°F. having existed for three days. She was discharged well on the sixteenth day after delivery.

The second pregnancy evolved normally. She was given a test of labor which lasted twelve hours at which time the vertex, which was presenting in left occipito anterior position, had not engaged. She was delivered of a male child by the *Hirst transperitoneal cesarean section on January* 1, 1925. The puerperium was uneventful and mother and child were discharged well from the hospital.

The third pregnancy was normal in all respects and on *August* 31, 1928 *a transverse cervical cesarean section* was performed before the onset of labor, a male child, who cried

spontaneously, being delivered. At the time of this operation the previous cervical scar could not be identified with the naked eye. Her had the diseases of childhood, but otherwise had been well. Her menstruation was established when she was twelve years of age. She

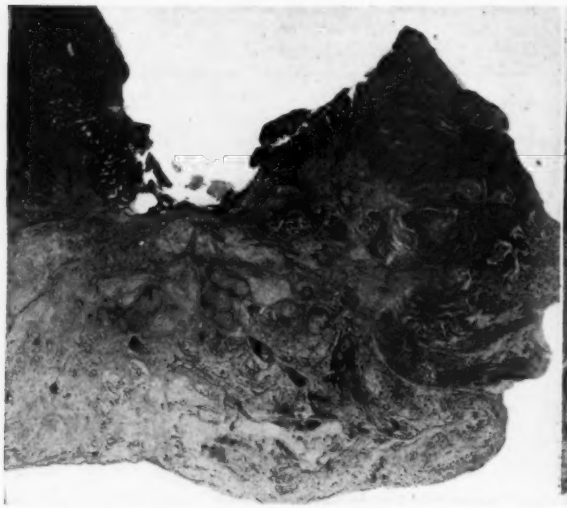

Fig. 1. Case 1. Scar of cervical cesarean section. Photomicrograph: Center of scar in wall of cervix following cesarean section. Scar tissue appears white, the smooth muscle gray to black. (× 5.)

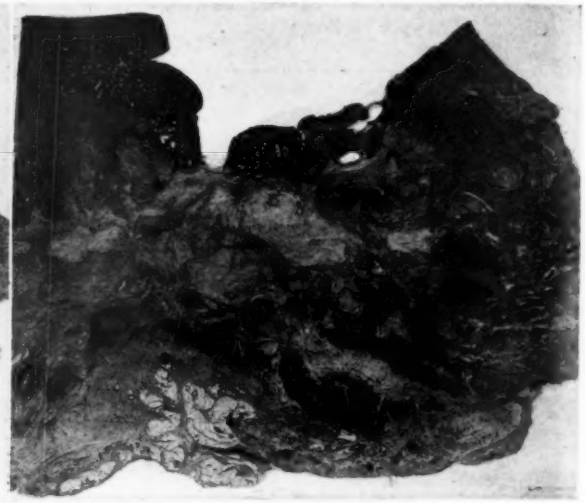

Fig. 2. Case 1. Scar of cervical cesarean section. Photomicrograph: Section towards one end of scar in wall of cervix following cesarean section. Scar tissue appears white, the muscle tissue gray to black. (× 5.)

convalescence was uneventful and both mother and baby were discharged well. The patient had then had two cervical cesarean sections, one with a longitudinal, the other with a transverse incision in the lower uterine segment.

On May, 17, 1929 the patient reported for examination, complaining of uterine hemorrhages. The general physical examination showed nothing remarkable. The pelvic examination revealed a laceration of the perineum, a deep laceration of the cervix and a large, boggy uterus. On June 3, 1929 she was operated upon under general anesthesia, a *vaginal hysterectomy, right salpingo-oopborectomy and perineorrhaphy being performed.*

The follow-up examination was made at my office on July 5, 1929. It was noted that the perineum was healed and gave good support. The vaginal vault was healed and well suspended. There was no pelvic tenderness. The patient was discharged cured.

The uterus was examined by Dr. Frank B. Mallory and photomicrographs of the anterior wall of the cervix were made (Figs. 1 and 2).

Case II. *History.* Mrs. E. D., thirty-seven years of age, was seen at the Marlboro Hospital, Marlboro, Mass. at the end of her first pregnancy, on May 27, 1926. There was nothing remarkable in her family history. She had menstruated every thirty to thirty-one days with pain, the periods being normal in amount and the last one occurring on August 20, 1925. She had been married eleven years and there had been no other pregnancies. The physical examination revealed no abnormalities. Obstetrically it was found that she had uterine bleeding, moderate in amount, a flat pelvis with a sharp promontory, that the fetal head was not engaged and that it was movable above the pelvic brim. On account of the bleeding, and because of her great anxiety for a living child after eleven years of marriage, a cervical cesarean section was decided upon. There had been no labor, the cervix was long and no vaginal examinations had been made. On May 27, 1926, under ether anesthesia, *a low cesarean section with a longitudinal cervical incision was performed,* and a female child delivered. There were no complications during the puerperium and both mother and baby were discharged from the hospital in good condition.

In 1929 the patient had a large lipoma of the left flank removed by another surgeon. I saw her again on August 13, 1930, four years after the performance of the cervical cesarean section. At that time she complained of a "bearing down feeling," backache associated with a

vaginal discharge, and for the six previous weeks she had constant pressure in the pelvis. Examination revealed a large firm mass filling the pelvis. Operation was advised and performed on August 13, 1930. Diagnosis: Cervical myoma, impacted. Operation: Panhysterectomy; double salpingo-oophorectomy.

Fig. 3. Case II. Scar of cervical cesarean section. In center of photomicrograph scar in wall of cervix following cesarean section. Epithelial lined cavities at left probably due to endometriosis. (× 10.)

A median abdominal incision from the symphysis to the umbilicus, resecting the scar of the previous cesarean section, was made. A small uterus was found resting on top of a large myoma which could not be delivered. The serosa was split over the myoma and with great difficulty the tumor was enucleated, following which the infundibulopelvic ligaments, the round ligaments and the uterine and vaginal vessels on each side were cut between clamps and ligated with No. 2 chromic catgut. The bladder was freely separated from the cervix and vagina. The vagina was opened just below the cervix, thus removing the myoma, uterus, tubes and ovaries. The vagina was closed with interrupted sutures of No. 2 chromic catgut. A cigarette drain was introduced in the center of the vagina. The round ligaments were sutured to the edges of the vaginal cuff with No. 2 chromic catgut. The anterior and posterior leaves of peritoneum were united with a continuous suture of the same material. A cigarette drain was placed in the cul-de-sac of Douglas and allowed to come out at the lower angle of the incision. The appendix looked normal and since the patient had had a sufficiently long operation, it was not removed. The omentum was brought down and the incision closed in layers. The patient was returned to bed in good condition. She had some signs of shock a few hours after operation, but this was easily overcome by appropriate treatment.

The pathological report, received from Dr. Frank B. Mallory, was the following: "Microscopic examination of specimen shows leiomyoma; no evidence of malignancy; negative tube; corpus hemorrhagicum."

The convalescence was uneventful and the patient was discharged well. It is interesting to note that no fibroids had been found in the uterus at the time of the cesarean section.

Photomicrographs were made from the previous cervical incision (Figs. 3 and 4).

Case III. *History.* Mrs. M. C., twenty-eight years of age, was seen at my office on April 4, 1923, during her second pregnancy. There was nothing important in her family history. She had had no serious illnesses but had had an operation, which consisted of an appendectomy, the removal of an ovary (it was unknown to her whether it was the right or left) and a suspension of the uterus performed in Waterville, Maine. Her menstrual history had been normal. Her first pregnancy had been terminated by a classical cesarean section for eclampsia in Waterville, Maine, and her second

and present pregnancy had evolved without complications to seven and one half months, when she was first seen. The pelvis was generally contracted. She carried this second pregnancy to full term and on May 22, 1923 was delivered at the Carney Hospital of male twins by a *low cesarean section with a longitudinal cervical incision*, the indication for operation being a previous classical cesarean section and a generally contracted pelvis. The incision in the body of the uterus, although appearing as a depressed scar, was firmly healed. She made an uneventful recovery and was discharged well, with her babies, who were in good condition.

FIG. 4. Case 11. Scar of cervical cesarean section. To right of center of photomicrograph scar in wall of cervix following cesarean section. Epithelial lined cavities at left probably due to endometriosis. (× 200.)

On September 4, 1931 she consulted me again for uterine hemorrhages in the form of menorrhagia and metrorrhagia. The examination revealed a large uterus in forward position; no other abnormalities were found. The next day a diagnostic curettage was performed, under local anesthesia.

The pathological report was the following: "Specimen consists of a mass of uterine curettings which make a pile on filter paper 2 cm. in diameter and 1 cm. in thickness. The tissue is pinkish red in color and a small amount of blood clot is present. Sections microscopically through the tissue submitted reveal the presence of numerous hyperplastic glandular structures, all of which are lined with normal epithelium. The adjacent stroma shows some hemorrhage and some round cell infiltration. There is no evidence of any malignant change in this tissue. Diagnosis: Chronic hyperplastic endometritis."

Despite the curettage the patient kept on flowing freely and because of this a hysterectomy was decided upon and performed on September 7, 1931. A median abdominal incision, resecting the previous pelvic scar, and entering the peritoneal cavity between the bellies of the recti muscles, was made. The omentum was adherent to the previous scar; the adhesions were freed and a rent in the omentum sutured with No. 0 chromic catgut. The left tube and ovary, together with the appendix had been previously removed. The right tube was closed, there being no fimbriated extremity, and the right ovary was cystic. On the right the infundibulopelvic ligament, the round ligament and the uterine vessels were cut between clamps. The bladder was separated freely and the cervix was cut across, close to the external os. The left broad ligament was then clamped and cut, thus removing the uterus supravaginally, together with the right adnexa. The remaining portion of the cervix was closed with three sutures of No. 2 chromic catgut. The vessels on each side were tied with the same material. All raw areas were covered over by suturing the edge of the bladder peritoneum

to the posterior surface of the cervix by means of a mattress suture of No. 2 chromic catgut. Examination of the anterior lip of the cervix *terior portion of the wall of the uterus is essentially normal in its appearance. The scar tissue is pearly gray in color and firm in consistency.*

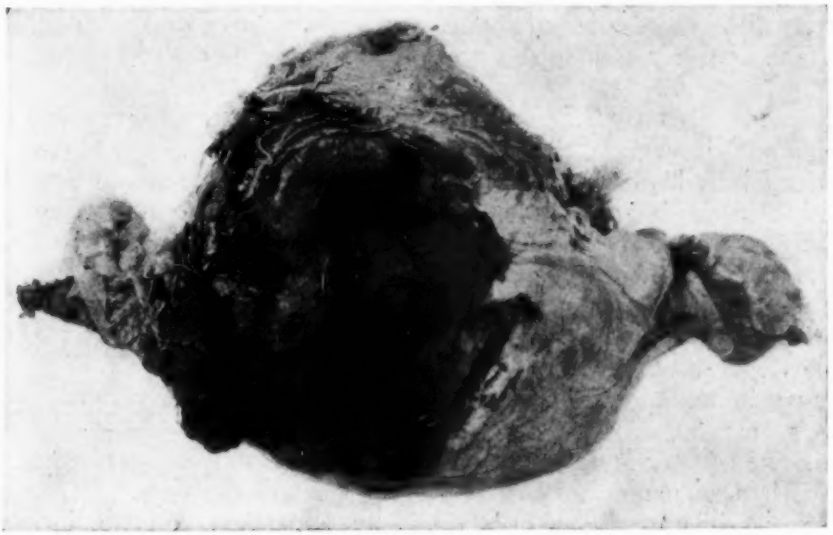

Fig. 5. Ruptured pregnant uterus following a previous classical cesarean section to show extent of rupture following that type of operation. From collection of Dr. Frank B. Mallory.

did not reveal the previous cervical incision. There was a depressed healed incision in the body of the uterus where the previous classical cesarean section had been done. Exploration showed the liver, gall bladder, spleen, kidneys, stomach and intestines to be normal. The incision was closed in layers.

The pathological report, submitted by Dr. J. Stewart Rooney, was the following: "Specimen consists of the uterus with the right tube and ovary attached. The uterus measures 8 cm. in length, 7 cm. in width and 4 cm. in thickness. Attached to the left upper portion of the anterior part of the uterus is an adhesion consisting of fat and fibrous tissue. In the mid portion of the anterior wall of the uterus is a depressed scar due to an operative procedure several years ago. This scar measures 3.5 cm. in length and 3 mm. in width. There is no evidence of scarring of either the cervix or wall of the uterus externally. On section through the wall of the uterus there appears to be some increase in fibrous tissue. The area of scarring due to the first cesarean section is extremely firm in consistency and pearly gray in color. *Further sectioning of the uterus reveals an area of scarring 1 cm. above the level of the cervical amputation. This area of scarring is only found in the anterior portion of the uterus. The posterior portion of the wall of the uterus is essentially normal in its appearance. The scar tissue is pearly gray in color and firm in consistency. Because of this scar tissue the uterine canal, at its lower portion, has become narrow. This area of scarring is due to the second cesarean operative procedure.* The endometrium is markedly thickened and is tan in color. The fallopian tube is somewhat tortuous and measures 5 cm. in length and 6 cm. in diameter. On section the wall is thickened, the lumen is patent and contains no puriform exudate. The ovary measures $3 \times 1.8 \times 1.4$ cm. On section it is found to contain numerous cystic structures, all of which are filled with straw-colored fluid.

"Sections microscopically through the wall of the uterus show some increase in fibrous tissue but aside from this present nothing unusual in their appearance. Sections through the region of both scars show them to be composed of fibrous tissue, characteristic of scar tissue. This shows some round cell infiltration. The endometrium is thickened and contains numerous hyperplastic glandular structures, all of which are lined with normal epithelium. The adjacent stroma shows some hemorrhage and some round cell infiltration. The wall of the fallopian tube is thickened and shows some round cell infiltration. The fronds are thickened and in many places adherent to each other. The lumen is patent and contains no puriform exudate. The ovarian tissue contains numerous

cystic structures, all of which are lined with normal epithelium. The adjacent stroma shows no evidence of any pathological change. There is no evidence of any malignancy in the tissue submitted for examination. Diagnosis: Fibrous uterus; scar tissue of the uterus; chronic hyperplastic endometritis; chronic salpingitis; cysts of the ovary."

Case iv. *History.* Mrs. H. C., twenty-six years of age, was seen in consultation in September, 1926. Her family history revealed that two sisters had died in infancy; otherwise, there was nothing remarkable. She had never had any serious illnesses or operations, but she had always been weak. Menstruation was established at the age of fourteen, the periods occurring regularly, every twenty-eight days; they were profuse in amount, lasting six to seven days, they were accompanied by backache and pain in the left pelvis and large clots were passed. She had been married five years and had two children. The first labor had been terminated as a breech delivery, the baby living one hour, and the second by the instrumental delivery of a female child, now living and well.

At the time of consultation, September 29, 1926, the patient was six months pregnant and was in active labor. The membranes had ruptured on September 26, 1926, three days previously. Hemorrhage, from the premature separation of the placenta, was present, together with toxemia of pregnancy. Under ether anesthesia a No. 4 Voorhees' bag was introduced. After about twelve hours there was no dilatation and the mother was showing signs of exhaustion. The bag was removed and she was quickly delivered, by vaginal cesarean section, of a female child, weighing 3 pounds. The baby lived only three days, but the mother made an uncomplicated recovery. On November 27, 1926 an examination showed the cervical and vaginal incisions well healed, the uterus involuted, in good position and the adnexa normal.

On April 30, 1929 the patient had reached term with her fourth pregnancy. She had been in the care of her family physician and had had no complications. She was delivered of a female child, now living and well, by a transverse cervical cesarean section, the indications being a justominor pelvis, high breech, previous vaginal cesarean section. At the time of operation two small fibroids were removed at the site of the incision and there appeared to be no others. The mother made a good recovery although her puerperium was complicated by sapremia and an extremely foul lochia. On August 2, 1929 an examination revealed that the abdominal incision was well healed, the perineum gave good support, the cervix was healed, the uterus was involuted, but pulled up to nearly the umbilicus, facing the abdominal incision, and the adnexa and parametria were normal.

She was next seen on October 23, 1931. She then complained of uterine hemorrhages accompanied by the passage of large clots. Examination revealed a myomatous uterus the size of a three months pregnancy and secondary anemia. On August 27, 1931 a blood transfusion was performed, 600 c.c. of citrated blood being administered. On August 28, 1931 a panhysterectomy, left salpingo-oophorectomy and appendectomy were performed. She made an uneventful recovery. On January 8, 1932 she was examined and the incision found to be healed, the vaginal vault was healed and suspended high in the pelvis, there were no areas of tenderness, she had gained 8 pounds in weight and was feeling well.

The pathological report, submitted by Dr. J. Stewart Rooney, was the following: "Specimen consists of a large uterus and includes the cervix. It is somewhat irregular in shape, this irregularity being due to the presence of large fibroids. The uterus, including the cervix, measures 14 cm. in length, 9.5 cm. in width and 4.5 cm. in thickness. The cervical portion of the tissue measures 4 cm. in diameter. One portion of the external surface of the uterus is quite rough and shows evidence of having been dissected away from the surrounding structures. Five millimeters of the vaginal wall is attached to the cervix so that the cervix is submitted in its entirety. *On the anterior lip of the cervix there is an old healed scar, this scar being due to an old operative procedure.* One portion of the cervix shows slight erosion. On section through the wall of the uterus there is found to be a marked increase in fibrous tissue and numerous fibroids are seen, the largest of which measures 4.5 cm. in diameter. *Five and one-half centimeters from the cervix on the anterior surface of the uterus there is an old healed scar, pearly gray in color and firm in consistency. This scar is due to a previous abdominal cervical cesarean.* The uterine canal is patent, the endometrium is thickened and is covered

with a hemorrhagic exudate. *A large fibroid has grown anterior to the scar where the cervical cesarean was performed.* The other fibroids are found scattered throughout the entire musculature. An ovary and the tube are also submitted for examination. The tube measures 10.5 cm. in length and 8 mm. in diameter at its widest portion. A small parovarian cyst is found attached to the tubal structure. The fimbriated end of the tube is patent. The wall of the tube is thickened, the lumen is patent and contains no puriform exudate. The ovary measures 5 × 3 × 1.5 cm. On section the ovary contains a large corpus hemorrhagicum, a normal appearing corpus luteum and numerous large cystic structures filled with straw-colored fluid.

"Sections microscopically through the wall of the uterus show a marked increase in fibrous tissue and numerous leiomyomata, all of which are characteristic in their appearance. *Sections through the region of the scar in the uterus show the uterine musculature to have been replaced by fibrous tissue.* The endometrium is thickened and contains numerous hyperplastic glandular structures, all of which are lined with normal epithelium. The adjacent stroma presents no change of importance aside from some round cell infiltration. Sections through the region of the cervix reveal the presence of numerous cervical glands, all of which are lined with normal epithelium. The adjacent stroma presents nothing unusual in its appearance. *In one area the cervical tissue has been replaced by scar tissue which shows a moderate amount of round cell infiltration.* The wall of the fallopian tube is thickened and infiltrated with round cells. The fronds are thickened and in many places adherent to each other. The ovarian tissue contains numerous cystic structures, all of which are lined with normal epithelium. The adjacent stroma presents no change of a pathological nature. The parovarian cyst, seen grossly, is characteristic in its appearance. Diagnosis: Fibrous uterus; leiomyomata of the uterus; scar tissue in uterus and cervix; chronic hyperplastic endometritis; chronic cervicitis; chronic salpingitis; cysts of the ovary; parovarian cyst."

SUMMARY AND COMMENT

Hysterectomies were performed on four women who had had previous low or cervical cesarean sections. Two of them had had one cesarean section with a longitudinal incision in the lower segment, another had had two cervical hysterotomies, the first with a longitudinal incision, the second with a transverse incision, and still another had had a vaginal cesarean section and then a transverse cervical cesarean section. The cervices, macroscopically, showed firm and satisfactory healing. Microscopically, it was shown that the healing had taken place by scar tissue and that no weak spots were found in these incisions. Rupture, such as is apparent in Figure 5 in the scar of a classical cesarean section, should be exceedingly rare in a healed cervical incision and these four cases give added proof of the solidity of the scar of the low or cervical cesarean section.

VALUE OF URETERAL RE-IMPLANTATION IN THE BLADDER*

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CONSIDERABLE doubt has existed as to whether it was worth while attempting to conserve a kidney involved kidney. Some authors, feeling skeptical as to the value of such re-implantations, have advocated ligating the ureter

FIG. 1. Case I. E. E., aged fifty-nine years. Excretory urogram two years and one month after left ureter neostomy. Ureter slightly dilated, left kidney slightly dilated. Good function. Bladder deformed on side of neostomy.

FIG. 2. Case II. J. S., aged thirty-five years. Excretory urogram two years and seven months after right ureter neostomy. Almost normal kidney and normal ureter on side of neostomy.

by re-implanting its ureter in the bladder, provided the other kidney was functioning normally. In a recent discussion in the French Urological Society, Marion[1] and Legueu[2] went so far as to say that re-implantation of a ureter in the bladder was an operation without any value whatsoever, and in the discussion it was stated that only one case was known in France in which re-implantation of the ureter had not been followed by destruction of the which was in question, and dropping it retroperitoneally, trusting that the kidney would undergo secondary atrophy, while others have advocated primary removal of the involved kidney. Of course, this would be done only in such cases in which the operator was sure that the second kidney was competent.

With the newer methods of investigation, especially excretory or intravenous urography, a much better estimation of the value of this operation can be reached.

* Read before the N. Y. Branch of the American Urological Association, Nov. 30, 1932.

Even before this remarkable improvement in the study of the anatomy and function of the kidneys became possible, from time to time surgeons of experience had been able to control the results of their re-implanted ureters by ordinary cystoscopy with visualization of the excreted indigocarmine, and in some cases with catheterization of the re-implanted ureter and retrograde pyelography. Occasionally also, it has been possible to determine the value of such a re-implanted kidney when a secondary operation or a necropsy has been carried out. In my own experience I have been repeatedly able to visualize a good strong indigo stream coming from a re-implanted kidney, and on several occasions where the re-implanted kidney at various periods after the ureteral implantation in the bladder had to be exposed or removed, I was able to convince myself that a major part of the parenchyma had been preserved, even though a moderate hydroureteronephrosis had developed.

With the use of intravenous urography, a new stimulus has been given to the study of this whole problem, and with the object of calling attention to this method of elucidating the problem, as well as to our results and technique of ureteral re-implantation, this short paper is written.

Owing to the underlying pathology which may compel the surgeon to implant a ureter in the bladder, in the past it has been most difficult in the majority of cases to determine preoperatively the condition of the involved kidney. Usually such a kidney is below par, either the seat of a hydroureteronephrosis, or dilated and infected, and owing to the involved ureter being more or less obstructed, catheterization, functional tests and retrograde pyelography are almost regularly impossible, so that the exact degree of damage is difficult to determine. During the last two and a half to three years, with the aid of intravenous urography, we have been able to visualize the degree of damage in the obstructed organ and can more readily decide whether such an organ is worth conserving; and of even more interest, we can compare the preoperative urograms with those obtained after the re-implantation. Unfortunately, in the majority of the neostomies that we have done, such a comparison is impossible, though in the last 6 cases in a series of over 40 re-implantations of the ureter into the bladder, we have been able to study the problem in this complete manner, and the results obtained in this series, as well as the intravenous urograms on patients without preoperative intravenous ureteropyelograms, demonstrate conclusively to our satisfaction that ureteral re-implantation is a valuable and useful procedure, and should regularly be employed, rather than ligation of the obstructed ureter, or immediate nephrectomy.

The 41 cases in which we have used ureteral re-implantation fall readily into the following simple groups:

A. Resection of the bladder wall and ureter orifice for carcinoma of the bladder, 30 cases.

B. Damage to pelvic ureter in gynecological operations, with ureterovaginal fistula, 4 cases.

C. Damage to pelvic ureter caused by peridiverticulitis, necessitating sacrifice of lowermost ureter, 4 cases.

D. Damage to lumen of lowermost ureter by extensive stricture formation or by stricture secondary to calculi, 3 cases.

A. URETERONEOSTOMY COMBINED WITH RESECTION OF BLADDER FOR CARCINOMA
TOTAL NUMBER OF CASES 30

Group 1. Cases in which kidney and ureter function were controlled by postoperative excretory urograms. Total number of cases 8.

Case 1. E. E., aged fifty-nine years; infiltrating papillary carcinoma. November 11, 1927, resection[3] and left neostomy (E. B.). Left ureter slightly dilated. December 31, 1929, excretory urogram, left kidney functions well, mild ureterohydronephrosis (grade 1

plus[4]). May 22, 1930, recurrence. March 8, 1932, re-operation, Memorial Hospital. July 2, 1932, excretory urogram, left kidney definite function, calices dilated, ureter visualized throughout and not dilated; right kidney good function, slight hydronephrosis (grade 1).

Summary: Excellent function over two years, and at almost five years, the left kidney is still functioning.[5]

Case II. J. S., aged thirty-five years; infiltrating papillary carcinoma. May 18, 1929, resection and right neostomy (E. B.). Right ureter slightly dilated and thickened. December 28, 1931, excretory urogram, right kidney functions well, slight hydronephrosis (grade 1); left kidney normal. March 22, 1932, no reflux by cystogram. April 3, 1932, extensive recurrence involving whole base of bladder. April 6, 1932, excretory urogram, left kidney not seen, right kidney moderate hydronephrosis. April 11, 1932, excretory urogram, neither kidney visible. Blood urea 25 mg. Apparently both kidneys blocked by large carcinoma, which necessitated a bilateral nephrostomy. June 1, 1932, metastasis (microscopic squamous carcinoma) developed in ilium, preventing total cystectomy.

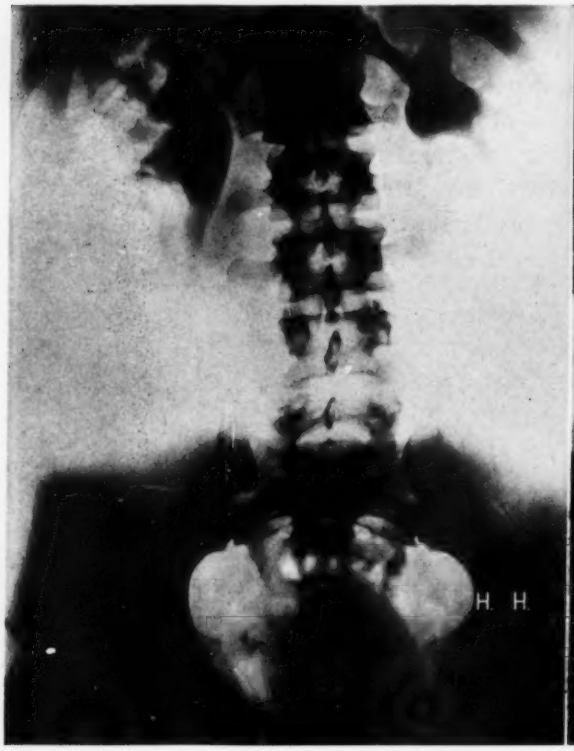


Fig. 3. Case III. H. H., aged twenty-four years. Excretory urogram 4 plus years after right ureter neostomy. Excellent function of almost normal right kidney. Ureter not definitely seen.

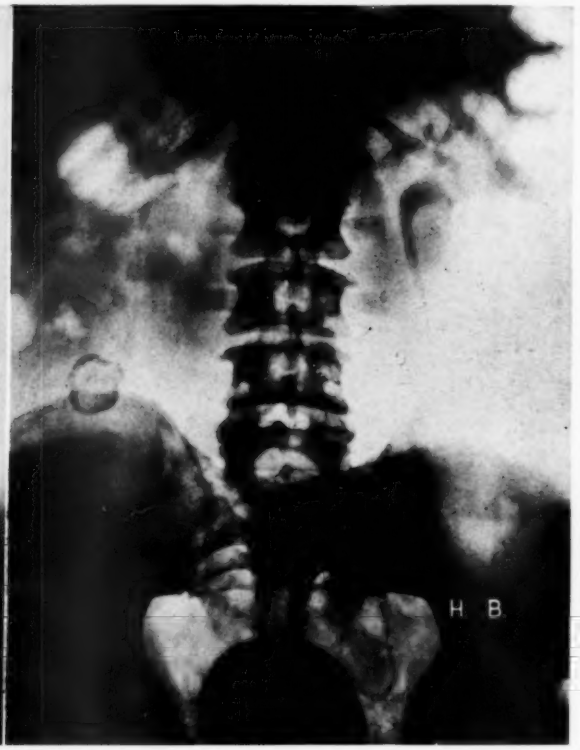


Fig. 4. Case IV. H. B., aged sixty-five years. Excretory urogram four plus years after left ureter neostomy. Normal left kidney and ureter, latter being looped in pelvis.

Summary: Excellent function for over two and a half years, when recurrence destroyed function of both kidneys. No reflux.

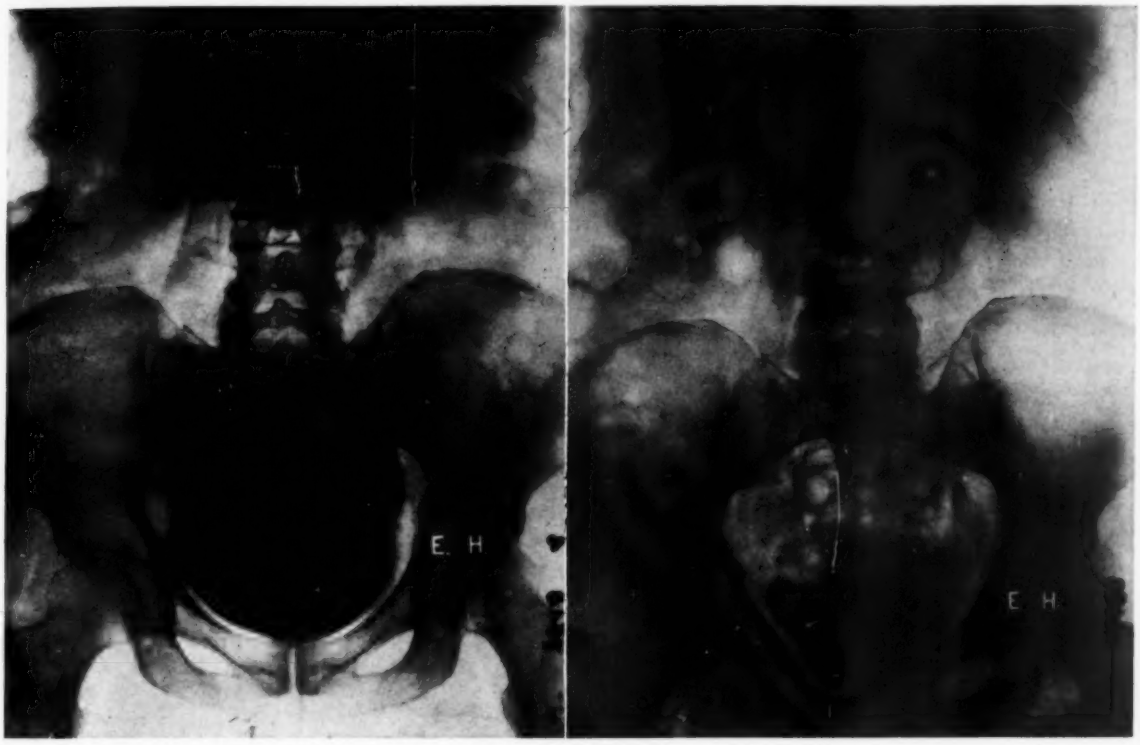
Case III. H. H., aged twenty-four years; papillary carcinoma. May 15, 1928, resection and right neostomy (E. B.). Right ureter dilated. Ureter catheter used as splint in neostomy. May 30, 1932, excretory urogram shows good function of both kidneys and mild, bilateral hydronephrosis, right and left sides (grade 1). Right ureter slightly dilated. Cystogram shows no reflux.

Summary: Excellent function over four years. No reflux. Bladder normal when last submitted to cystoscopy, December 3, 1930.

Case IV. H. B., aged sixty-five years; papillary carcinoma. June 26, 1928, resection and left neostomy (P. Aschner). Catheter used in neostomy as splint. July 8, 1928, excretory urogram, both kidneys function well, kidney pelves are normal, no dilatation of ureters.

Left ureter makes a wide curve before entering bladder.

Summary: Excellent function over four years.



A B

Fig. 5. Case v. E. H., aged sixty-two years.

A. Excretory urogram before operation shows dilatation of left ureter and slight dilatation of left kidney pelvis.

B. Excretory urogram three and a half months after left ureter neostomy, showing practically same condition; if anything lower ureter less dilated and upper ureter more dilated. Bladder deformed as result of resection.

Normal upper urinary tract. Last cystoscopy normal, strong indigo-carmine from both sides (May 4, 1929, L. Mann).

Case v. E. H., aged sixty-two years; infiltrating papillary carcinoma. Preoperative excretory urogram, right kidney normal, left kidney shows ureterohydronephrosis (grade 1 plus). June 12, 1930, resection and left neostomy (E. B.) before the American Urological Association. Postoperative use of radium bomb in vagina. September 26, 1930, excretory urogram, right kidney normal, left ureterohydronephrosis (grade 1 plus). September 29, 1931, excretory urogram, right kidney normal; left kidney faint visualization. June 23, 1932, excretory urogram, right kidney normal; left kidney shows indistinct shadow of a slightly enlarged kidney and faint filling of some of the calices. The left ureter is not dilated.

Summary: For over three months, the left kidney functioned as well as preoperatively. A little over two years postoperative, the kidney still functions, but much less well, and may be going on to an extensive hydronephrosis, grade 2–3, even though the left ureter is definitely not dilated. Whether the extensive use of radium per vagina caused some local cicatrization cannot be determined. Cystoscopy April 22, 1931, showed normal bladder as well as in December, 1932.

Case vi. J. W., aged sixty-three years; transitional cell carcinoma. October 10, 1931, preoperative excretory urogram, both kidney pelves and calices normally small and delicate. Right kidney still shows filling at sixty-five minutes, while left kidney is almost empty. October 14, 1931, resection and left neostomy (E. B.). January 4, 1932, excretory urogram, left kidney moderate ureterohydronephrosis (grade 1 plus). July 16, 1932, excretory urogram, left kidney functions less well, left ureter is definitely dilated and left pelvis enlarged (grade 2). Cystogram shows no reflux.

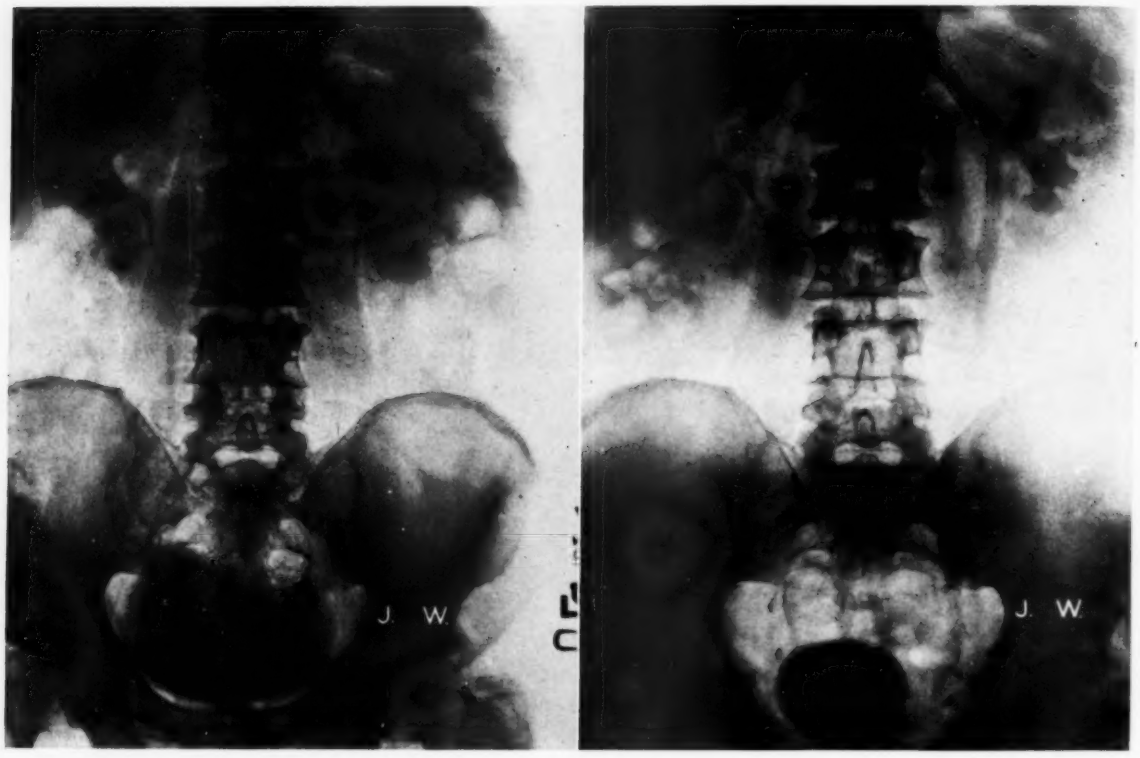
Summary: In this case, we had a preoperative absolutely normal excretory urogram. Two and

a half months following the neostomy, though the left kidney was functioning well, evidence of commencing hydronephrosis was found, and at ten months, the hydronephrosis had progressed to grade 2. No reflux.

Case VII. H. S., aged fifty years; papillary carcinoma (?). September 25, 1931, excretory urogram, both kidneys normal. September 25, 1931, resection and right neostomy (A. Hyman). November 9, 1931, excretory urogram shows both kidneys normal as before operation. April 16, 1932, excretory urogram, right kidney shows slightest dilatation (grade minus 1), whereas left kidney is visualized poorly. Cystogram shows no reflux.

Summary: Almost two months after the neostomy, the upper urinary tract is normal, as compared with the preoperative urograms. At seven months, there is the slightest dilatation of the right kidney pelvis, but the left kidney function is not nearly as good. Apparently the right kidney is doing the major work. No reflux.

Case VIII. A. J., aged fifty-nine years, infiltrating carcinoma. Preoperative cystogram shows reflux up both ureters. July 7, 1930, resection and right neostomy, radium into neck and prostate (E. B.). October 18, 1930, excretory urogram, left kidney normal; right kidney much dilated (grade 2 plus). Prostate became nodular, recurrence, general enfeeblement and November 30, 1930, exitus.



A B

Fig. 6. Case VI. J. W., aged sixty-three years.

A. Excretory urogram before operation shows normal delicate pelvis and ureter.

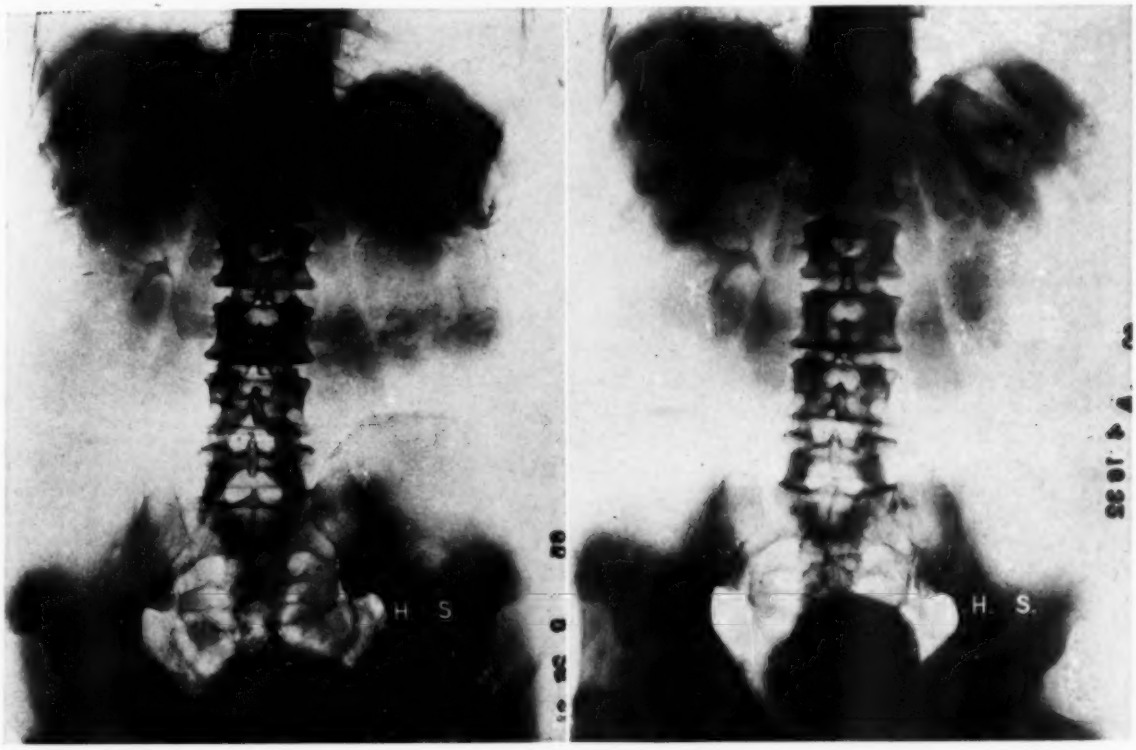
B. Excretory urogram three plus months after left ureter neostomy shows slight dilatation of whole left ureter and kidney pelvis and calices. Bladder deformed on left side due to resection.

Postmortem examination showed recurrent carcinoma with pelvic infiltration, right hydroureteronephrosis, *left pyoureteronephrosis and pyelonephritis.*

Summary: Excretory urogram two months following neostomy showed an extensive hydronephrosis of the right kidney confirmed by autopsy. The left side had, however, also suffered greatly, and was badly infected.

Recapitulation: If we review these 8 cases, it is apparent that in every instance, no damage was done to the patient by the ureteral re-implantation, and that in 7

out of the 8 cases, the primary functional studies by means of excretory urography showed satisfactory conditions. Moreover, dysuria, relieved by suprapubic cystostomy. June 25, 1928, pain and tenderness in right lumbar region with fever led to right nephrec-



A B

Fig. 7. Case vii. H. S., aged fifty years.

A. Excretory urogram before operation, showing normal, delicate pelvis, with slightest dilatation of pelvic portion of left ureter.

B. Excretory urogram seven months after right neostomy showing almost normal right kidney and upper ureter.

in at least 5 out of 8 cases, tests made up to several years after the neostomy showed excellent functional results, with little or no damage in the upper urinary tract. Despite the fact that no attempt was made to produce a valvular implantation, in 4 cases that were cystogrammed, no reflux was demonstrable.

Group II. Cases in which re-implanted kidney was seen at later operation or autopsy. Total number of cases, 5 (including Case viii).

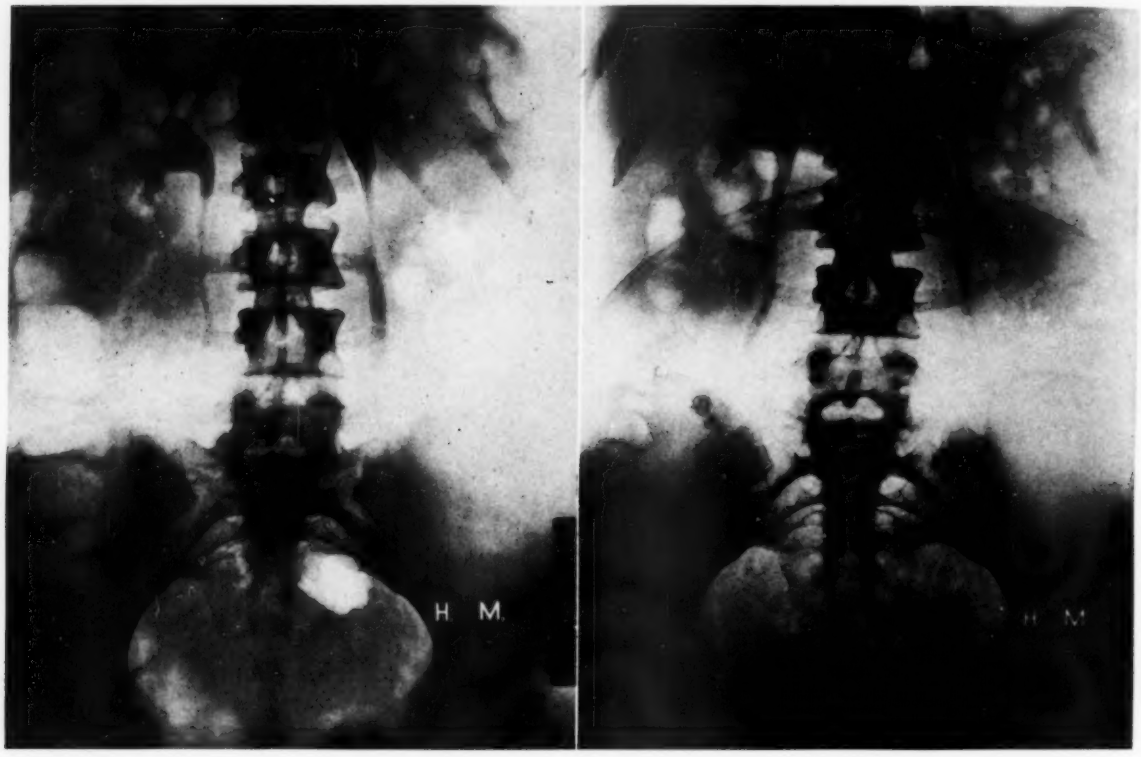
Case ix. I. B., aged forty-six years; infiltrating papillary carcinoma. July 30, 1923, resection and right ureter neostomy (E. B.). February 28, 1924, strong indigocarmine from right kidney. April 10, 1928, small papilloma destroyed, infection in bladder causing great tomy April 17, 1929, for pyelonephritis. Specimen showed perinephritis with edema, ureter size of lead pencil. Parenchyma of almost normal thickness with multiple subcapsular abscesses. Pelvis inflamed and moderately dilated. During 1930–1932, similar attacks of ascending pyelonephritis in left kidney.

Summary: Six years following neostomy, patient developed, perhaps from open bladder, an ascending right pyelonephritis, and as the cystoscopic approach was barred by the suprapubic drainage, the right kidney had to be operated upon and removed. The kidney, except for the acute infection, was almost normally preserved, and almost undeformed.

Case x. D. M., aged fifty years, infiltrating papillary carcinoma. March 22, 1927, resection and right ureter neostomy (E. B.). Some postoperative right lumbar pain and tenderness. September 6, 1928, cystoscopy, no recur-

rence, good indigo-carmine from both sides (L. Mann). January 26, 1929, right lumbar pain with temperature to 104°F. January 31, disclosed a fairly well preserved, moderately hydronephrotic and inflamed kidney.

Case xi. M. M., aged thirty-seven years;



A B

Fig. 8. Case xxxi. H. M., aged twenty-three years.

A. Excretory urogram ten months after left ureter neostomy, showing normal upper urinary tract.

B. Excretory urogram two and three-quarters years after left ureter neostomy, showing normal upper urinary tract, perhaps slightest dilatation of left lumbar ureter.

1929, cystoscopy for hematuria. No indigo-carmine from right kidney. January 22, 1930, excretory urogram, shows no function right kidney. November 22, 1931, control excretory urogram, no visualization of right kidney. Complains of attacks of right lumbar pain and hematuria. December 4, 1931, right nephrectomy and partial ureterectomy for suspected obstructed and infected hydronephrosis with atrophy. Parenchyma well preserved in thickness, about two-thirds normal. Postoperative exitus.

Postmortem examination showed left pyelonephritis and slight hydronephrosis, adenoma of left kidney, thrombosis left renal vein, B. coli bacteriemia, marked myocardial degeneration.

Summary: Almost five years following neostomy, nephrectomy for attacks of pain and hematuria, with occasional febrile movements, infiltrating papillary carcinoma. October 6, 1916, resection and left ureter neostomy (E. B.). Preoperatively, left kidney large, blocked ureter. Postoperatively, both kidneys tender. December 17, 1916, suprapubic fistula persists, apparently due to infected left kidney, probably present prior to operation, perhaps following the neostomy. January 27, 1917, left kidney exposed, ureter markedly dilated, kidney not much enlarged and grossly normal. Indigo-carmine injected into ureter as it was exposed in wound, appears at once in suprapubic fistula. Kidney and ureter removed, and February 9, 1917, suprapubic fistula was closed. February 20, 1919, recurrence treated at Memorial Hospital. April 15, 1919, Dr. Barringer reports bladder normal, but extravesical vaginal tumor. June 1919, exitus.

Summary: In this patient, there was undoubtedly a partial blockade of the left ureter

prior to operation, and as a most extensive subtotal resection (two-thirds plus) was done, the patient developed ascending infection of both kidneys. The persistent fistula and the tenderness on the left side led to exposure of this kidney and ureter three months after the neostomy, and though the ureter was much dilated (size of adult thumb), the kidney was grossly almost normal, but the seat of a pyelonephritis. Following exposure of ureter, it was injected to prove patency of neostomy, and indigo appeared at once in the bladder suprapubic sinus.

Fig. 8c. Same case. Excretory urogram two and three-quarters years after left ureter neostomy, showing ureters in pelvis absolutely normal in caliber, and on left side, whole ureter is filled, as well as kidney and calices showing normal contour. Impossible to distinguish between two sides as to which had been operated upon.

Case xii. S. H., aged sixty-six years; papillary infiltrating carcinoma. June 11, 1921, resection and left ureter neostomy (E. B.). Postoperative fever, azotemia (urea 53.2 mg.), semi-stupor. July 14, 1921, after improving and being out of bed, temperature rose again. Cystoscopy showed good indigo-carmine from right kidney, left ureter not seen. In view of temperature, left kidney exposed and July 18, 1921, nephrectomy carried out (P. Aschner). Specimen showed slight congestion of pelvis and upper ureter and fat. Kidney, however, was not distended, and not acutely infected. July 19, 1921, pneumonia and pulmonary edema, exitus.

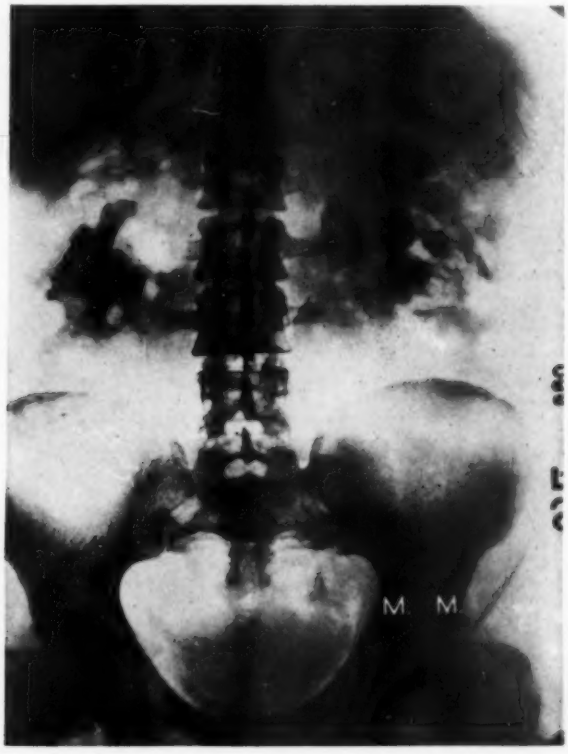


Fig. 9. Case xxxix. M. M., aged thirty-five years. Excretory urogram one year and seven months after left ureter neostomy, showing good function of left kidney. Left pelvis and calices dilated, but lumbar ureter, just below pelvis of normal caliber. Right kidney shows dendritic stone.

Summary: About one month after a neostomy, the kidney was exposed under the impression that it had become obstructed at the new orifice and then infected. The specimen failed to confirm this diagnosis, the kidney was not distended or acutely infected.

Recapitulation: In these 4 cases (ix–xii), the re-implanted kidney was exposed, and, contrary to expectation, was remarkably well preserved and very little dilated. In one case, the neostomy was tested by retrograde injection and found patent.

Group III. Cases in which patient died following the original operative procedure. Total number of cases, 4.

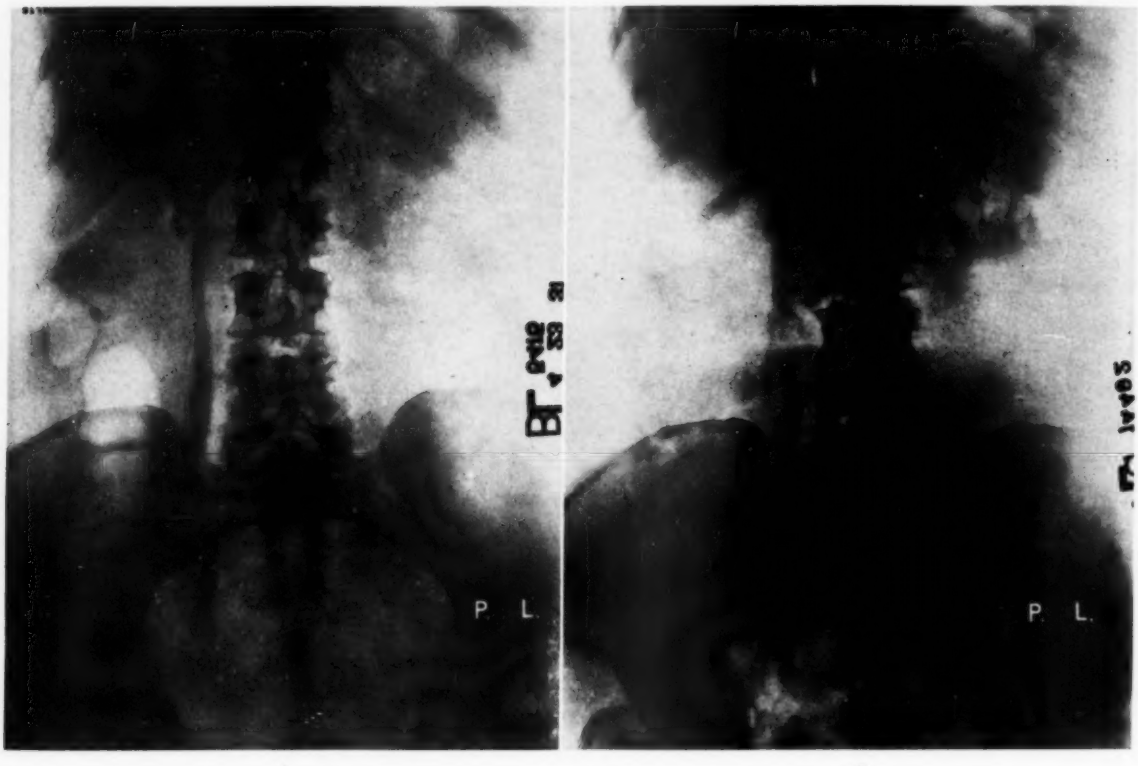
Case xiii. M. H., aged sixty-four years, extensive carcinoma and diverticulum. Resection and left neostomy, diverticulectomy (E. B.). Cardiac failure and shock.

Case xiv. S. O., aged sixty years, extensive carcinoma, resection and right ureter neostomy, plus radium (E. B.). Shock, etc.

Case xv. N. K., aged fifty years, extensive carcinoma. Resection and left neostomy. (E. B.). Shock.

Case xvi. C. N., aged sixty-three years, infiltrating carcinoma. Resection and right neostomy, diverticulectomy and ligation of left ureter (E. B.). Shock.

Recapitulation: These 4 postoperative deaths in this group, usually due to shock as the operations were most extensive, gives us an immediate mortality of 13 per cent. Whether the neostomy has added to this mortality is doubtful, though the effort at conservatism involved in this procedure may delay and prolong the operation. The mortality is a trifle higher than that of total cystectomy in our hands (4 in 30 versus 1 in 9 cases). Total cystectomy in many of these extensive involvements is preferable both as to final result and apparently as far as the immediate mortality is concerned, and should be employed in these cases, provided consent is obtainable, much more frequently.



A B

Fig. 10. Case xli. P. L., aged fifty years.

A. Retrograde pyeloureterogram before operation, showing dilated pelvis and obstructed lower ureter, ending in bulb. Picture taken seven hours after injection of iodide soiution.

B. Excretory urogram before operation, showing practically same condition with bulbous lower end of right ureter.

Group IV. Cases which have been followed and controlled for years following the neostomy. In some control cystoscopies have been possible, in others only physical examination. Total number of cases, 14.

Case xvii. B. S., aged forty years. Resection and right neostomy (L. Buerger). Control cystoscopy within a few months showed good function. No symptoms from right kidney.

Case xviii. N. B., aged fifty-eight years. Resection and right neostomy (E. B.). Recur-

rence in bladder and prostate three years later, exitus. No symptoms from right kidney.

Case xix. I. B., aged sixty-two years. Resection and left neostomy (E. B.). Exitus seven years after operation. No symptoms.

Case xx. E. P., aged forty-nine years. Cauterization of neoplasm and left neostomy (E. B.). Heard from four years later, well, no symptoms. Left kidney pains complained of preoperatively, relieved.

Case xxi. L. I., aged forty-one years. Resection and left neostomy (E. B.). No follow-up.

Case xxii. H., aged fifty-five years. Resection and left neostomy (E. B.). Postoperative left kidney pain and fever of temporary character. One year later, lithotomy for vesical calculus. Exitus three and one-fourth years after operation due to coronary disease. No evidence of further disturbance of left kidney.

Case xxiii. C. J., aged forty years. Resection and left neostomy (E. B.). Seven months later, calculi in bladder. Some right kidney tenderness. Two and one-fourth years following operation, exitus due to pneumonia. No symptoms referable to left kidney.

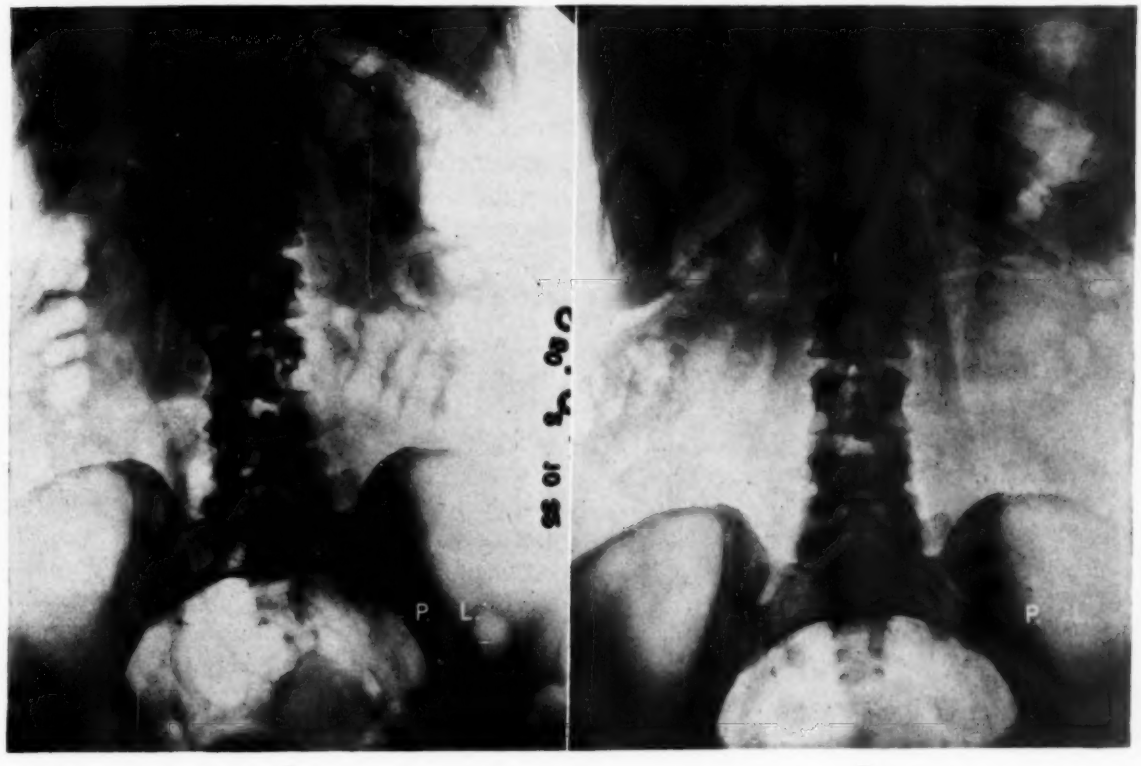
Case xxiv. M. L., aged fifty-six years. Resection and right neostomy (A. Hyman). Cystoscopy three months later, good indigocarmine from right kidney. Bladder normal. Four years later in good health.

Case xxv. J. K., aged fifty-five years. Resection and right neostomy (A. Hyman). No kidney symptoms, no definite recurrence. Cystoscopy six months following operation.

Case xxvi. L. S., aged forty-one years. Resection and right neostomy (A. Hyman). Metastases. Lead therapy at St. Lukes Hospital. Ten months after operation, no kidney symptoms.

Case xxvii. I. B., aged fifty-two years. Resection and left neostomy (A. Hyman). Developed pain and tenderness in left kidney. Died fourteen months after operation, recurrence.

Case xxviii. J. K., aged sixty-four years. Resection and right neostomy (A. Hyman),



C D

Fig. 10. c. Same case. Excretory urogram four plus weeks after right ureter neostomy, showing right kidney pelvis much smaller and ureter filling all way down to bladder, only moderately enlarged.

d. Same case. Excretory urogram three and a half months after right ureter neostomy, showing marked diminution in size of right kidney pelvis, excellent function, lumbar ureter well outlined, normal caliber.

plus radium. Six weeks after operation, committed suicide.

Case xxix. F. F., aged fifty-two years.

Fig. 10e. Same case. Excretory urogram three and a half months after right ureter neostomy, showing right ureter all way down to bladder, apparently of normal caliber.

Resection and right neostomy (A. Hyman). Developed right lumbar tenderness, lung metastases, and died eight months after operation.

Case xxx. D. B., aged fifty-three years; infiltrating papillary carcinoma. February 10, 1928, resection and right ureter neostomy (E. B.). Splinted with ureter catheter, which failed to drain (right kidney functionless?). Developed fever, right kidney tenderness, periostitis symphysis. Re-admitted July 9, 1928. Suprapubic sinus, left kidney tenderness, azotemia (122 urea), metastases to bones. December, 1928, exitus, bilateral ascending pyelonephritis. No autopsy.

Summary: Whether the transplanted kidney functioned well preoperatively is not certain. Postoperatively both kidneys gave symptoms of infection, which led to death ten months following the resection.

Recapitulation: In these 14 cases, at least 8 showed no kidney symptoms following the operation. On 2 cases, there was no adequate follow-up, and in 4 cases, there was definite evidence of temporary or more serious renal infection.

If we review these 30 cases of resection of the bladder with ureteral re-implantation, it is evident that this procedure is not only of great value, but preferable to any other procedure and should be carried out whenever a wide resection sacrifices the ureteral orifice. In the great majority of cases, a satisfactory functional result is obtained and the patient's more or less obstructed kidney is conserved. If infection is already present in the involved kidney, neostomy may drain it satisfactorily; perhaps in the few unsatisfactory cases, the poor result is due to such an uncontrollable kidney infection. These satisfactory results are all the more surprising as all the bladders were drained suprapubically by tubes and no attempt was made to effect an oblique implantation through the bladder wall.

B. Ureteroneostomy following injury to ureter in the course of gynecological procedures and for ureterovaginal fistulae

Total number of cases 4

Case xxxi. H. C. M., aged twenty-three years. October, 1928, gynecological, transvaginal procedure and ten days later vaginal urinary leakage. March 8, 1929, left ureter neostomy (E. B.), extraperitoneal route. Bladder drained with a transurethral Pezzer catheter. April 29, 1929, cystoscopy, left ureter catheterized, no indigo-carmine in twenty-five minutes (intramuscular injection), specimen clear. Right, kidney strong indigo-carmine. January 27, 1930, excretory urogram shows normal left ureter and kidney. Right pelvis slightly dilated. December 8, 1931, excretory urogram shows absolutely normal pictures in both kidneys and ureters.

Summary: Two and one-half years following left neostomy, the excretory urogram shows normal function of the upper urinary tract, with no trace of dilatation.

Case xxxii. P. B., aged twenty-eight years. 1924, panhysterectomy for carcinoma, followed by urinary vaginal leakage of ten months duration. June 5, 1925, right ureter neostomy (E. B.), extraperitoneal. Ureter

twice normal size, thickened and fibrotic. Pezzer catheter in bladder transurethral. August 26, 1925, cystoscopy, right ureter projects into bladder like a nipple. Ureter easily catheterized, and, as before the neostomy, no indigo-carmine excretion in thirty minutes (intramuscular injection). No postoperative right kidney discomfort. No opportunity for excretory urogram.

Summary: Following right neostomy, patient made an uneventful recovery and right kidney gave no symptoms. At cystoscopy, ureter readily catheterized, and clear urine obtained. Apparently the re-implanted kidney was working as satisfactorily as prior to the neostomy.

Case xxxiii. E. B., aged thirty-four years. Following hysterectomy for carcinoma, developed a left ureterovaginal fistula. Preoperative excretory urogram showed left hydroureteronephrosis (grade 2). January 24, 1931, left ureteroneostomy (A. Hyman), extraperitoneal. February 17, 1931, excretory urogram, same as preoperative. August 25, 1931, excretory urogram, unchanged.

Summary: This case was followed by several excretory urograms, which could be compared with the preoperative urogram. The last urogram was made seven months after the neostomy, and the re-implanted kidney and ureter showed the same functional activity and conformation as prior to the neostomy.

Case xxxiv. A. M., aged twenty plus years. During the course of a hysterectomy, the left ureter was cut by the gynecologist, and immediately re-implanted, apparently intraperitoneally. The patient came to me twenty years later complaining of fever and chills with pyuria. April 7, 1928, cystoscopic and pyelographic studies showed a moderately dilated left ureter, and slight left hydronephrosis with concentric atrophy of the parenchyma. Secretion from the left kidney almost nil. March 5, 1930, excretory urogram, left kidney does not visualize, while right kidney is clearly seen and functions well.

Summary: In this case, a complete, almost aseptic destruction of the re-implanted kidney took place, which was recognized some twenty years after an intraperitoneal neostomy. The suspicion is aroused, in view of our own experiences and others published in the literature, that the use of the intraperitoneal route, as opposed to the extraperitoneal, may have contributed to the end result. The exact technique used in the anastomosis is not known, but the atrophic hydronephrosis simulated the end result of an aseptic kidney exclusion, so that I suspect the technique employed may have produced temporary (three weeks or more) occlusion of the ureter and consequent aseptic exclusion.

Recapitulation: In these 3 cases of neostomy performed by the extraperitoneal route, in which the bladder was drained with a urethral Pezzer catheter, the results were uniformly ideal. In fact, without the record, in the excretory urogram in the 2 cases studied in this manner, one could not determine which kidney had been re-implanted.

C. Uretero-neostomy in cases of extensive peridiverticulitis and periureteritis, in which lower ureter had to be sacrificed

Total number of cases, 4

Case xxxv. S. L., aged three years. Pyuria and dysuria for six months. February 11, 1922, cystoscopy, bladder diverticulum in region of right ureter. No indigo-carmine from either kidney. February 25, 1922, diverticulectomy and right ureter neostomy (E. B.), extraperitoneal. Right ureter much dilated and adherent. Uneventful recovery. No kidney tenderness. January 12, 1924, patient well, no frequency or pain. Urine slightly hazy. Both kidneys palpable. Cystoscopy not performed.

Summary: In this child, the neostomy was followed by no symptoms suggesting involvement of the corresponding kidney. Unfortunately, we could not reach the patient for an excretory urographic control.

Case xxxvi. M. B., aged ten years. Dysuria and hematuria with right lumbar tenderness. Cystoscopy showed diverticulum on left side, good indigo-carmine from both ureters. Left ureter appears to empty into diverticulum. Cystogram shows reflux up right ureter and a diverticulum. March 27, 1915, diverticulectomy and left ureter neostomy (E. B.), extraperitoneal. Left ureter much dilated. May 11, 1915, cystoscopy, left ureter nipple shaped in midline. Strong indigo-carmine within thirteen

minutes. Right ureter, strong indigo-carmine in fifteen minutes. March 1922, patient well, urine clear. Refused cystoscopic control.

Summary: In this child, a good functional result seems to have followed the re-implantation. Here as yet, an excretory urogram has not been obtainable.

Case xxxvii. S. B., aged forty-eight years; diverticulum of bladder. April 8, 1932, cystoscopy, diverticulum right side. Right ureter not found, left ureter normal. Cystogram shows large right sided diverticulum. Excretory urogram shows double left kidney and ureter. On the left side, ureters fuse opposite sacroiliac synchondrosis. Marked hydronephrosis and hydroureter on left side. Right kidney, no function. April 21, 1932, diverticulectomy and right neostomy (A. Hyman). June 15, 1932, excretory urogram, right kidney functions, pelvis not well outlined; left kidney and ureter as before operation. Developed phlebitis of left lower extremity, suprapubic wound opened and closed intermittently, and June 30, 1932, exitus. Postmortem examination showed bilateral pyelonephritis with abscesses, distention of right kidney pelvis, forked ureter left side. Right side, retroperitoneal abscess communicating with bladder. Pneumonia right lower lobe. Verrucous endocarditis aortic valve.

Summary: In this interesting case, following the neostomy the function of the re-implanted kidney improved or returned, as evidenced by the preoperative and postoperative urograms.

Case xxxviii. M. S., aged sixty-six years; diverticulum of bladder and plastic ureteral neostomy. 1926, prostatectomy. Suprapubic sinus persisted and cystoscopy showed a large diverticulum on the right side. The right ureter could not be seen, no indigo-carmine on this side. Good indigo-carmine left side. January 7, 1927, excision of diverticulum, into which right ureter opened almost 1½ inches from bladder. Flap from diverticulum with hinge at bladder sewed about freed ureter, which was pulled into bladder and covered with this flap (E. B.).[6] March 7, 1927, cystoscopy showed finger shaped projection at infolded ureter area with good indigo-carmine excretion.

Summary: As this was not a free ureter re-implantation, it does not definitely belong in the group that is under analysis in the paper. It is of interest as demonstrating the feasibility of re-inserting a ureter into the bladder without sectioning it and doing a free re-implantation.

D. Ureteroneostomy for Extensive Stricture Formation in Lower Ureter, or for Stricture Due to Calculus

Total number of cases, 3

Case xxxix. M. M., aged thirty-five years; stricture of lower ureter (2 cm.) following calculi. Right kidney dendritic calculus. Thick pus exudes from left ureter on cystoscopy, no indigo-carmine. May 2, 1930, left ureterolithotomy and left ureter neostomy (A. Hyman), extraperitoneal. Probe could not be passed into bladder. June 4, 1930, bilateral lumbar tenderness. Cystoscopy, left ureter meatus not visible. August 20, 1930, excretory urogram, enormous distention on both sides, left ureter larger than right ureter. February 17, 1931, right pyelonephritis. Nephrolithotomy under *x*-ray control (A. Hyman). Excretory urogram unchanged. September 28, 1931, excretory urogram again showed marked bilateral dilatation. January 20, 1932, excretory urogram, right kidney only moderately dilated. Left kidney more so. Both sides functioning. July 8, 1932, cystogram shows no reflux on neostomy side, slight reflux on right side.

Summary: In this case, the neostomy undoubtedly saved the patient's left infected kidney, and diminished the risk of the later nephrolithotomy on the second kidney.

Case xl. E. G., aged twenty-seven years; extensive calculous stricture of lower 3 inches of left ureter in patient with a solitary kidney. In this patient, a transperitoneal lateral anastomosis had to be made between the lower dilated left ureter stump near the level of the iliac vessels, as the lowermost ureter was stenosed for 3–4 inches. The history of this case, already published in part[7] need not be reproduced here, as it is too lengthy. The anastomosis tended to stenose and had to be splinted by use of a large rubber catheter, which was introduced from a lumbar ureter opening into the bladder. Through a side hole in this, the urine leaked from the ureter into the bladder and was voided. Patient has borne a child since the anastomosis. November 23, 1931, oral excretory urogram (M. Swick) shows enormous dilatation of left kidney calices, and left ureter. June 3, 1932, attack of ileus due to adhesions, and appendicectomy (appendix in left upper quadrant) (A. Hyman). July, 1932, general condition good.

Summary: This, like Case XXXVIII, does not belong in this study, but again is included for completeness' sake. It illustrates another method of approaching this problem when the ureter and bladder are so far apart that adequate mobilization for an extraperitoneal anastomosis is impossible.

Case XLI. P. L., aged fifty years. Stricture of lower right ureter with hydroureteronephrosis. Retrograde urogram shows extensive dilatation of both ureters and kidney pelves. Patient had recurrent obstructive symptoms on the right side, and the retrograde filled right kidney did not empty completely after seven hours. Lower end of the ureter bulbous and dilated and remained so despite stretchings continued over months and years. Excretory urogram showed same ureterohydronephrosis with stricture in right ureter close to the bladder. January 5, 1932, right neostomy (E. B.), extraperitoneal. Stricture found behind uterine vessels. Considerable periureteritis. Indwelling urethral catheter. Considerable urinary leakage from wound, as if ureter had pulled out. Tension had been considerable at operation, the large thick ureter being freed retroperitoneally well into the lumbar gutter, and the bladder was mobilized as well. January 25, 1932, cystoscopy, right ureter easily catheterized. February 11, 1932, excretory urogram shows good function both sides. February 27, 1932, chills, fever, frequency and right kidney pain and tenderness. Cystogram in Trendelenburg position shows no reflux. Symptoms subsided and April 20, 1932, excretory urogram shows right kidney empties well and the ureterohydronephrosis is now less marked (grade 1 plus). September 10, 1932, cystoscopy, good indigo-carmine at fifteen minutes from right kidney, number 5 ureteral catheter passed to kidney pelvis and 15 c.c. clear urine aspirated.

Summary: Though repeatedly stretched, the ureter stricture recontracted, and a right ureter neostomy had to be done. Despite one attack of right pyelitis, the excretory urogram shows good function and marked change for the better in the size of the right ureter and kidney.

From a careful perusal of the pictures based on excretory urograms and the data taken from the abbreviated records of the foregoing series of ureter bladder anastomoses, it must be evident that this operation is a most valuable procedure in the pathological conditions in which we have employed it. Moreover, it must be equally evident that the clinical results are surprisingly satisfactory and that apparently in the great majority of patients, the re-implanted kidney functions well, and is of great value to the host.

Judging from the literature, there are other conditions than the four groups just mentioned in which such neostomies may be required, e.g., injury to the ureter during labor, diverticula of the lowermost ureter, congenital, abnormal position of the ureter orifice (urethral, vaginal, etc.). In these three groups, we have had no opportunity to do a neostomy.

Turning to the literature again, we find reports of various attempts to re-establish continuity, etc., as early as 1876 (Nussbaum[8]), and in the intervening years, a large number of authors have published isolated cases or small groups of cases in which this operation has been done with apparent success. The very fewest cases, however, have been checked up by cystoscopic control, and even fewer by the method of excretory urography. One of the earliest cases proved to be a success by control cystoscopy was reported by the late Florian Krug in 1894 (transperitoneal). J. M. Baldy reported 2 similar cases about the same time, and in one there was a satisfactory result as checked up by cystoscopy. During the next decade, under the influence of Stoeckel, Franz and Kroenig, particularly in connection with the carrying out of the Wertheim operation for carcinoma of the cervix, ureteral neostomy became a more frequent procedure. Stoeckel in Germany and Sampson in America gave much study to this operation, and developed many phases of the surgical technique. But even in those days, prior to functional tests and retrograde pyelography, it was not clear how satisfactory the end results were, as it was realized that secondary, aseptic ureteral stenosis, the equivalent of a ligation, might lead to a symptomless renal exclusion. All the earlier cases, 57 in

all up to 1902, were gathered together by D. Bissell.[9]

With the development of the surgery of the urinary tract, especially since bladder carcinoma became a legitimate field of surgical endeavor, the operation under discussion assumed much more importance, and was done much more frequently. In the earlier development, gynecologists and obstetricians saw the patients that required this operation, whereas in the last decades, the urologists and the surgeons probably see more cases in which a neostomy is required than do the other specialists, especially since radiotherapy is displacing the Wertheim operation. In 1917, E. S. Judd[10] reported 21 cases, 17 of which were done in association with resection of the bladder for carcinoma, and only 4 for injuries caused by labor or hysterectomy. In those cases (number not mentioned, E. B.) that were controlled by cystoscopy, the ureter was found patent, and the urine seemed to escape continuously, rather than in spurts. In the 17 bladder carcinoma cases, the operation was done transperitoneally, and 3 patients died (18 per cent). From the same clinic (Mayo's), A. Peterson,[11] reporting apparently on these same cases, gives somewhat different figures, but goes into more detail concerning the cystoscopic control made from eighteen days to four and a half years postoperative, and states that in 17 controlled cases, 53 per cent showed normal function, 18 per cent fair function and 30 per cent no function. He concludes, a little too enthusiastically, from experimental and clinical observation, that it is obvious that a normal or almost normal kidney and ureter should result following implantation of the ureter into the bladder. Long, Rathbun, Pinkham (bilateral neostomies), Gibson, Furniss, Stoeckel, Mikulicz-Radecki, Dannheiser, Boeminghaus, Hammel, Leishner and Chevassu have added successful results to the more recent literature.

In many of the later cases, careful cystoscopic studies, even occasional excretory urograms, have been made to demonstrate the functional value of the re-implanted kidney. So Dannheiser[12] (Rosenstein) controlled 6 cases, six months to ten years postoperatively, and in 5 cases (really 4), he claims good indigo-carmine return, and a fair excretory urogram in one of these. He quotes Hammel, who re-examined 6 cases, one to twelve years after neostomy, and 4 showed good results. Milkulicz-Radecki[13] from Stoeckel's clinic reports on 10 controlled cases two months to four years after neostomy. The control was by catheterization pyelogram excretory urogram and indigo-carmine excretion, and he found kidney function maintained, though at times there was a slight hydroureteronephrosis. It is a pleasure to add our series of cases to the literature to confirm the work of others and to strengthen the argument in favor of doing neostomies when indicated.

Many surgeons have thought that a reflux would take place up the re-implanted ureter, and would be serious objection to a neostomy. As yet, I know of only one such case, proved by cystogram by Stoeckel[14] four years after the operation. According to the experiments of W. Isreal no such reflux occurs in animals subjected to the same procedure, and in the 6 cases which were cystogrammed in our series, no reflux was observed. This is all the more surprising as no attempt is made to produce a valvular meatus, the end of the ureter usually being pulled directly into the lumen of the bladder through an adequately large incision into the viscus, at some convenient extraperitoneal area. There is nothing complicated in the technique employed. Tension must be avoided, which is invariably easily accomplished. An opening is made into the bladder, the ureter end is cut in its long axis for 1–1.5 cm., and it is drawn into the incision in the bladder wall with a thin chromic gut suture that perforates the bladder distal to the incision, then comes out through the incision, takes a broad cross mattress bite on the opened ureter and then enters the

bladder lumen and perforates its wall near the original entry of the needle (suture). By traction the loop pulls the ureter through the opening well into the bladder and then two more sutures of similar material attach the adventitious coats of the ureter on either side to the bladder wall. Drainage is made on the mesial side of the anastomosis with rubber dam, no gauze being used. If this has to be used for hemostasis in the floor of the pelvis, the anastomosis must be well protected by rubber from contact with the gauze. We have the impression that some of our poor results may be due to too much and too prolonged drainage which may lead to cicatricial periureteritis, and thus affect the ureteral peristalsis. As far as we can see, splinting with catheters of the anastomosis has not helped and was used only occasionally to prevent a possible edematous stenosis when there was undue trauma or a questionable second kidney. In all but two of the reported cases, the neostomy was done extraperitoneally, and in the two transperitoneal anastomoses, the results were not in any way comparable to the extraperitoneal re-implantations.

In this brief paper, involving as it does the work of many years, it is impossible to touch on all the interesting points that present themselves. I feel sure the study of this extensive series was well worth while, and that it demonstrates conclusively the great value of the operation of re-implantation or neostomy of the ureter into the bladder, whenever the lower ureter is damaged or its meatus has to be sacrificed in a bladder operation.

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4. Grades are one to three. One means slightest variation from normal; 2 well marked dilatation; 3 extensive, large hydronephrosis.
5. The clearest urograms of the series are reproduced. At this time in some of the cases the urogram of the second (normal) kidney may be indistinct as it may have partially or completely emptied.
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DISCUSSION

Dr. G. F. Cahill: It is only within the last few years that we have had an opportunity to study the result of ureteral transplantations by means of secretory urograms. My experience in cystoscopic studies of ureteral implantations is that it was often impossible to catheterize the ureters, and I had to depend upon excretion dye tests to determine the renal status.

The majority of ureteral transplantations in our cases were done for tumor resections of malignancies involving the ureteral orifice. This type of case necessitates a wide resection of the bladder and removal of the lower end of the ureter, with the fascia and tissues attached. The transplantation of the cut ureter was effected in the same manner as described by Dr. Beer.

In checking up the tumor resections with ureteral transplantations, there is about 15 per cent hospital mortality. In these cases the value of the ureteral transplantation is not known and cannot be considered. Of 39 of our cases 9 patients died within three months after operation and 8 died within a year, most of these from metastasis. In 3 of these cases symptoms arose referable to the kidney on the transplanted side, which necessitated removal of the kidney for pyonephrosis. In our opinion a recurrence of the tumor in the tissues of the pelvis adjacent to the ureter was a factor in causing the pyonephrosis. There were 22 patients who lived more than a year. Of these I could find no symptoms referable to renal disturbance on the transplanted side. There were 4 of these patients known to have died from later metastasis without renal changes in the terminal illness. Of the remaining 18, most have been traced for a sufficient number of years to rule out renal deterioration.

Four patients had ureteral transplantations that were done for non-malignant gynecological causes. These had been transplanted with a technique similar to that of Dr. Beer. In none of these were there symptoms referable to the transplantation, none was malignant and so offered an opportunity for better transplantation. There was more elasticity in the pelvis and the transplantation could be made without tension.

We have had 5 cases of ureteral ligation. Of these, 2 required nephrectomy following the procedure. One was for a huge leiomyosarcoma of the fascia between the urethra and the cervix. In the removal of the tumor with the ureter there was not a sufficient ureter remaining to reach the bladder, so it was ligated. Within three weeks it was necessary to remove the kidney for pyonephrosis. The second patient had a tumor with extension outside the bladder; and after removal of all the areolar tissue of that side of the pelvis with the involved ureter there was not sufficient ureter to reach the bladder. The ureter was ligated, and again a pyonephrosis resulted, necessitating nephrectomy.

In the other 3 cases, the kidney has remained silent, one for a year, the second two and one-half years, and the third three and one-half years.

Rarely, we find cases with stricture of the ureter such as Dr. Beer has described in his fourth group, where a transplantation of the ureter offers the best chance for preservation of the kidney. I saw today a man on whom, nine years ago, I did a ureteral transplantation for stricture of the ureter due to a stone imbedded in the ureter over a long period. After treatment for a prostatic disturbance for a number of years a series of excretory urograms showed as good renal function on the transplanted side as on the untouched one, with a mild grade A hydronephrosis on the transplanted side.

It is good surgery to save the function of a good kidney. It is known that kidneys preserve their function when drained by pyelotomies or nephrotomies. How much better, then, could the kidney preserve its function if the ureter could be drained into the organ naturally intended to receive it! It is reasonable to assume that the function would persist better than elsewhere.

Dr. Beer states that he has not seen any reflux in the transplanted ureter. I have had 2 cases in which over-distention of the bladder with urine has at times given severe renal colic on the transplanted side.

Dr. H. D. Furniss: The restoration of function is the point of importance. The majority of my cases have been those associated with injuries to the ureter following hysterectomy for fibroids or for carcinoma. In most of these the kidney, the ureter, and a sinus tract drained into the bladder. In practically all there is dilatation of the ureter above the injury. With the excretory pyeloureterogram we are able to determine the degree of the dilatation, and also locate the lower end of the ureter. If the obstruction is too high to prevent doing a good anastomosis, we leave the kidney alone, trusting to final elimination, take the kidney out, or implant the ureter into the rectum.

In the future, in cases with marked dilatation of the ureter and infection, I shall drain the kidney to allow it to get rid of the infection, restore function, and get less exudate in the pelvis (which is a hindrance to successful neostomy). It increases the possibilities of good function. I have not had the success Dr. Beer has. However, on one patient operated upon thirteen years ago good function was obtained, as demonstrated by indigo-carmine, and only the slightest dilatation was shown by the pyelogram.

Dr. Abraham Hyman: The technique originally described by Dr. Furniss is simple and gives good results. A small stab opening is made in the bladder; the end of the ureter is cut obliquely and passed through this opening, projecting about three-quarters of an inch into the lumen of the bladder. In one case of resection of one-half the bladder for carcinoma there was tension when the lower end of the resected ureter was brought into the bladder. In this instance a ureteral catheter was passed into the ureter and brought out through the suprapubic opening, thus guarding against leakage.

Can a kidney with a markedly dilated ureter function even after transplantation? This question may be illustrated by a woman who was admitted to the hospital following a gynecological operation one year previously. A hysterectomy had been performed for carcinoma of the cervix, and an ureterovaginal fistula had developed, all the urine leaking through the vagina. Intravenous urograms showed marked dilatation of the left pelvis and ureter, all the way down to within ½ inch of the bladder,

where the ureter was adherent to the vaginal wall. Despite dilatation and marked enlargement of the kidney, there was good function of the organ. The other kidney showed slight dilatation.

We decided, in view of apparently good function of this kidney, to do the usual extraperitoneal transplantation into the bladder. Four months later, an intravenous urogram showed good function on the transplanted side. The ureter was somewhat more dilated than prior to operation, but there was good function. The patient returned for control seven months after the operation, and good function of the kidney again was confirmed. The lower end of the ureter was seen entering the bladder. Cystoscopy showed a large ureteral orifice on this side, which was readily catheterized and good emptying found.

Dr. O. S. Lowsley: Our 14 cases all fall into the first group of Dr. Beer's classification. The ureters were all transplanted for carcinoma, and we found great variability as to whether there was reflux or not. My opinion is that if the patients live long enough, they have reflux ultimately. In those I have examined a number of years after the procedure, all have showed reflux.

I have long been seeking a method of transplanting ureters into the bladder in an oblique manner. This is difficult on account of the thin walls of the bladder. Dr. Vermooten of Yale recently has developed a method of oblique transplantation. He separates the mucosa and submucosa from the musculature, and runs the ureter through this for a distance of an inch or so.

The first case of transplantation I ever did was on a soldier upon whom I removed a carcinoma from the right ureteral orifice, with the lower end of the ureter, and transplanted the ureter in June, 1918. That was fourteen years ago. He is alive today, and in excellent condition, although at times he has had exacerbations of pyelitis on his right side and distress. The right kidney functions actively.

Dr. N. P. Rathbun: My own experience is limited to 6 cases. It seems a striking fact that 30 out of 41 of Dr. Beer's cases were done after resection for carcinoma of the bladder. Only one of my cases was of that type. This patient did well as far as the neostomy was concerned, but died several months later from carcinoma of the bladder. I hesitate to bring up this point, but in the greater number of cases of carcinoma of the bladder, the growth has invaded the trigone, and a large percentage involve both the ureteral orifices and trigone. I have a feeling that in such cases resection of the bladder is insufficient. I believe that if one is going to do a radical operation, the ureter should be put into the rectum or the skin, as Dr. Beer often has done, and a total cystectomy performed. With the development of the ureterosigmoid operation, I believe this will prove the method of choice. I think these cases are better treated with massive doses of radium.

Two of my cases were treated for diverticulum. A perfect result was obtained in one; in the second, a nephrectomy was necessary three weeks after the operation. I believe that where we have a large, thickened ureter, with thick, purulent urine, the best procedure is to put a tube into the ureter, bring it out through the wound or a stab wound in the groin, and later do a nephrectomy. In such cases we cannot do a primary nephrectomy, as we are not sufficiently familiar with other factors in the case. These are cases where the chances are obviously against conserving kidney tissue.

Two cases were treated for damaged ureters, where the ureters were cut in hysterectomy. In both instances they were transplanted into the bladder four weeks after the first operation, with good results. This is an ideal indication for the procedure. In both cases the fistulas were cured, no clinical symptoms resulting. One refused control cystoscopy. The other was seen two years after operation, and good indigo-carmine obtained.

The sixth case was a bilateral transplant for a diverticulum of the lower end of each ureter. The patient made an excellent recovery. Four years after operation the parents would not permit cystoscopy but we found the blood chemistry normal, and clear urine with only a few white blood cells, and a normal phenosulphonephthalein test. There was only a very mild hydronephrosis.

The technique of the operation as described by Dr. Beer is simple. Mine is even simpler. The two major points are, first to avoid tension at the site of the anastomosis, and second, that drains be kept away from that point. I make a stab wound in the bladder, pull the ureter through, leave ¾ inch of the ureter redundant, and fix it with a couple of sutures on the outer side of the bladder.

Dr. Clyde L. Deming: Our experience is limited to 6 cases of section of the ureter with

reimplantation into the bladder. There were 6 other cases in which we did not treat the ureter in this way.

The first patient had a diverticulum of the bladder. The operation was not difficult, and the end result was ideal. There was no infection in the bladder some months after operation. That was several years ago, and the last we heard the patient was in excellent condition.

In two instances we operated for carcinoma of the bladder. Both patients, elderly men, died, of severe urinary infection and general sepsis, one a month, the other two months following operation. Autopsies showed stricture at the point of anastomosis in both cases. I feel this operation should not be performed in individuals sixty-five or seventy years of age.

The next two patients in whom we transplanted the ureters were younger. The operation was successful, but the urines remained infected. One showed purulent urine. Specimens of urines from the other case were grossly clear but microscopically showed infection and cultured B. coli.

The last case was a gynecological accident. We attempted to insert the ureter into the bladder. Some tension resulted, and a nephrectomy was required.

In 4 later cases of carcinoma of the bladder we cut off the ureters high up and allowed the kidney to atrophy. One patient has lived three years and another eight months without recurrence of the tumor. These cases are recent but urines have become free from infection as shown by culture and immediate stain. Two very recent cases showed ureters which emptied into a large diverticulum. We transplanted a portion of the diverticulum in each case and did not cut the ureters. The patients were relatively young. A severe bladder infection previously existed, but disappeared after the operations.

From our experience that it is difficult to cut the ureter, transplant it and give the individual an absolutely sterile urinary tract. The question arose in our minds whether we would rather have one infected kidney and the other free from infection, or whether we should have only one kidney functioning and the urinary tract absolutely sterile. With this as a basis and realizing that strictures form at the point of anastomosis, my associates, D. Vermooten and Neuswanger, have done very extensive work re-implanting the ureters into the bladder in dogs. In practically every experiment, the anastomosis shows stricture regardless of the presence or absence of infection. However, I believe the operation has distinct advantages within certain limits where it is necessary to preserve kidney function for a while.

Dr. V. Vermooten: There is such a tremendous difference between the reactions of a dog and a human being that my findings may be relatively unimportant to you. The bladder of a dog is almost entirely an intraperitoneal organ, and we do not get as satisfactory results experimentally in this type of operation as we would on a human being. With the assistance of Dr. Neuswanger of Waterbury, I began to work on the bladder implants, and found there was a good deal of peritoneal leakage after transplants in animals, and that the method of transplantation ordinarily used on human beings was unsatisfactory. I had to devise another method. I was also eager to find a way of transplantation which would exclude a patent ureter and regurgitation of the bladder contents. I did a transplant of the rectosigmoid (Coffey type). The dogs all died of urine peritonitis.

I then devised a method of drawing the ureter through into the bladder and making a slit in the bladder mucosa, lifting the mucosa off and laying the ureter in the bed, sewing that over and so forming a good valve. This proved interesting from several viewpoints. The ureters transplanted in this way were very much more satisfactory than any other transplants. In a certain number of these cases, the ureters were perfectly normal three or four months later.

In other transplants we tried to simulate the ordinary type of transplantation by making a stab wound into the bladder. In order to prevent leakage we used a large needle, pulled the ureter through on a suture, and got a fairly tight wound in the mucosa. Whether this was the case or not, I do not know. But in most of these cases there was a certain amount of hydronephrosis, and in many a great deal of infection. In only a very few were the ureter normal after several months. Autopsy results on reimplants into the large bowel showed that where hydronephrosis and dilated ureters developed there was definite stricture of the ureter where it passed through the mucosa into the rectum, except in one case.

With our transplants into the bladder we gained the general impression that in most instances, as in our urterosigmoid anastomoses, dilatation was not due to regurgitation, but to stricture at the site of the anastomosis and to infection.

Dr. J. Sturdivant Read: Six years ago we had a case of a dilated ureter in a man of twenty-seven. A diverticulum necessitated reimplanting the ureter. We followed the patient for two years, and found good function. We could discover no reduction in the size of the ureter. Then he disappeared for four years, married and had two children. All this time the urine had been cloudy. Three months ago he began to have pain in the kidney on which the ureteral transplant had been done.

I saw him a few weeks ago, and cystoscopy showed a nipple-like implant from which was emerging a pencil of yellow pus. That kidney had become a pus sac. It was tender and painful; nephrectomy was necessary. The kidney was removed and found to be the seat of many abscesses extending from various calices into the parenchyma close to the capsule. About one-fourth the kidney was healthy tissues. The active process appeared to be, as judged by the parenchyma, not more than three months old. The ureter was still dilated but not obstructed.

Dr. Edwin Beer (*Closing*): It was interesting to note that in the 6 patients that were cystogrammed after ureter bladder anastomosis, not a single one showed an incompetent ureter opening with reflux. Some of these cystograms were made over four years after operation. The experimental work of William Israel along these lines also failed to show any reflux after cystogram.

In looking over our series of cases, it did seem as if some of the poor results might be due to the fact that prior to operation there was no knowledge as to the degree of destruction of the involved kidney nor any knowledge as to the degree of infection. Fortunately, since the introduction of excretory urography, we are in a better position to get a preoperative view of the kidney's pathology and function. The presence of infection, plus the added infection of long suprapubic drainage probably influences some of our results. In cases where no suprapubic drainage was done and there was no kidney infection, as demonstrated in the excretory urograms, the end results are surprisingly satisfactory, and the anatomy of the ureter, if it shows any change, is in the direction of normalcy.

Perhaps, in some of our cases where the result was less satisfactory, we used too much and too long protracted drainage outside of the bladder. This may lead to periureteritis and stenosis with secondary obstruction of the infected kidney. In view of this, we are now using, mesial or lateral to the anastomosis, one rubber dam drain and no gauze. In the few cases where gauze has to be used to control postoperative oozing, the anastomosis is protected from the gauze by a sheath of rubber tissue.

One of the interesting deductions drawn from this series of bladder resections is that over 40 per cent were alive and well after their resections for infiltrating carcinoma three years or more after operation, which seems to indicate that the wider the excision, the better are the end results in this type of case. Any attempt apparently to spare the ureter orifice if a tumor approaches this region should not be made, in view of the excellent results obtained by wide resection. Many of these cases which have been reported might have had better results, especially the 4 patients who died, had we done a total cystectomy. In most of these patient cited, permission could not be obtained so that we were forced to do the best for the patient that an extensive resection might offer. The mortality in total cystectomy in this type of case would probably be less than an attempt to re-anastomose after an almost complete cystectomy, with re-implanting one or both ureters into the bladder in a new place.

In concluding, it is important to emphasize the fact that if the patient following anastomosis has no symptoms on the side of the kidney that has been re-implanted, that the kidney is not necessarily functionally or anatomically almost normal. There is no doubt that some of these cases in which this operation has been done, and which are included in my fourth group of carcinoma resections, may have undergone secondary atrophy, just as if the ureter had been ligated. It is only by extensive use of excretory urography that we can decide definitely how often this type of exclusion takes place. The same exclusions occur after radium is implanted about a ureter orifice, but how often following radium implantation this occurs has yet to be demonstrated by this novel radiographic procedure.

ANNULAR STRICTURE OF THE RECTUM AND ANUS

TREATMENT BY TUNNEL SKIN GRAFT
PRELIMINARY REPORT

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IT is not my intention to discuss, in this brief preliminary report on the treatment of annular strictures of the rectum and anus, the greatly disputed question of their etiology, or to go into details, other than to call attention to the fact that rectal strictures are often present in cases in which syphilis, gonorrhea, tuberculosis and endometriosis cannot be proved to be, either directly or indirectly, a causative factor. In anal strictures a history of previous trauma or surgical operation is very often obtained. The inflammatory strictures of syphilitic origin are seldom, if ever, permanently relieved by specific treatment, except in the early stages, and as a result practically all such cases coming under my observation have been treated either by surgical measures or mechanical dilatation.

The 8 cases included in this series belong to that type of derelict passed along from one hospital to another after dilatation, colostomy, some form of plastic operation or treatment by irrigations to overcome the septic proctitis so often present in this condition, has been tried. These procedures have been satisfactory in temporarily alleviating the sufferings of these unfortunates, but they do not give permanent relief.

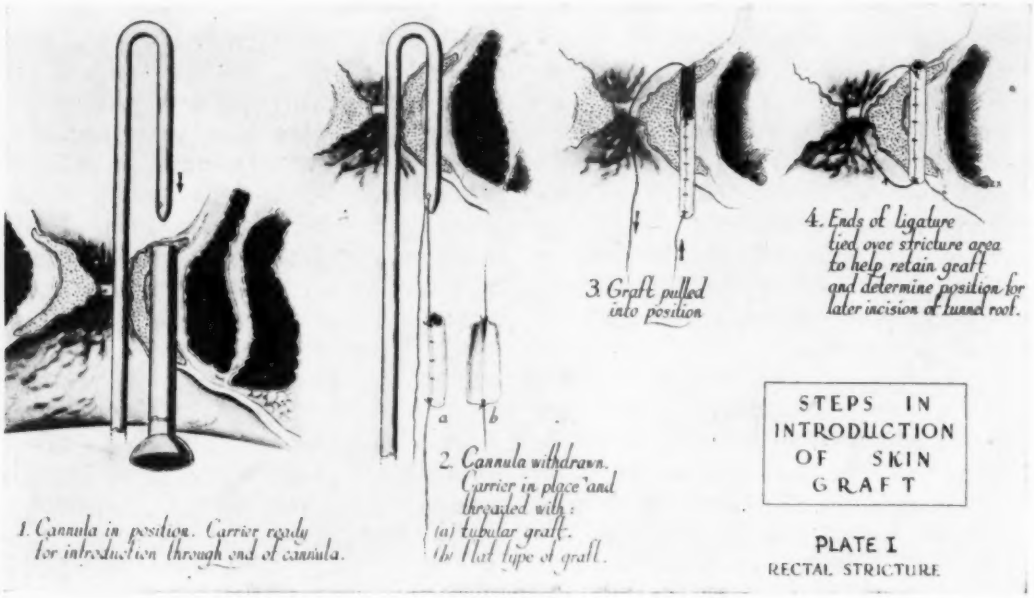
1. Cannula in position. Carrier ready for introduction through end of cannula.
a
b
2. Cannula withdrawn. Carrier in place and threaded with: (a) tubular graft. (b) flat type of graft.
3. Graft pulled into position
4. Ends of ligature tied over stricture area to help retain graft and determine position for later incision of tunnel roof.
STEPS IN INTRODUCTION OF SKIN GRAFT
PLATE I
RECTAL STRICTURE

PLATE I

The operation advocated, and described briefly herein, applies only to the common varieties of troublesome annular strictures seen in the distal 3 or 4 inches of the rectum, and in anal strictures. It does not remove the causes of the original strictures, or guarantee against the formation of strictures at other points in the rectum.

Tubular strictures, extending close to the rectosigmoid junction, are not amenable to this form of treatment.

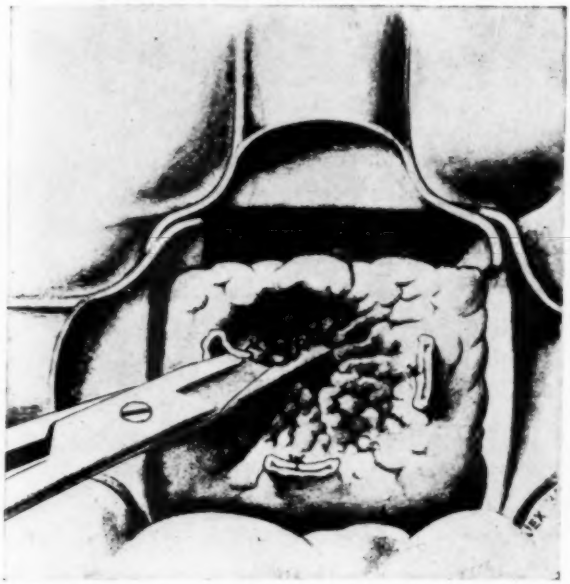

Plate II. Stricture tunnel over graft being divided.

PREOPERATIVE TREATMENT

The lower bowel is irrigated twice daily with a 5 per cent lysol solution for several days to diminish the septic proctitis usually present. If the stricture be so small that the proper irrigations cannot be carried out, it is wise to either dilate the stricture or divide it at one point. It is a well-known fact that no amount of preoperative preparation will render this septic field aseptic, as in many of these cases the strictures are often complicated by small fistulas and areas of ulceration that extend into the adjacent tissue; on the other hand, judging from the free growth of skin in the grafted areas, it is also questionable whether the rectum can be dangerously infected. The external parts are shaved and prepared in the usual manner.

OPERATION

In grafting a stricture of the rectum or anus, full thickness grafts are taken from a hair-free area and thinned down as desired. If the tubular type is to be used, it is sewed with catgut in that shape around a trocar. A long ligature of black silk thread is sewed at each end. This same type of

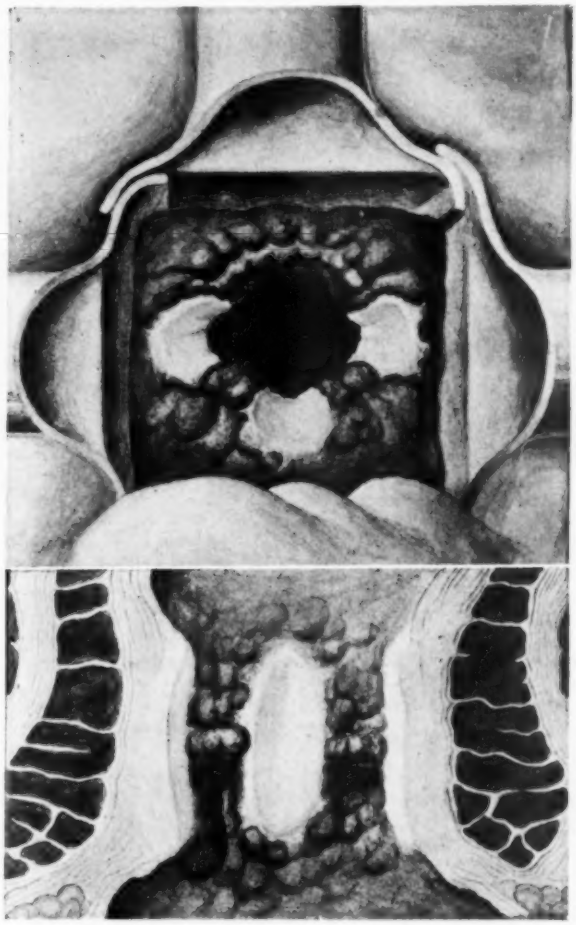

Plate III. Grafts in position three months later.

ligature is inserted when flat grafts are used. The stricture proper is exposed by means of any standard rectal speculum or retractors. A trocar and cannula are then passed under the stricture, and the trocar is withdrawn, leaving the cannula in place under the stricture and mucous membrane, as illustrated in Plate I, Figure 1. The U-shaped carrier, as shown, having a long and short arm, is now passed into the rectum above the stricture. The point of the short arm of the carrier is pressed through the mucosa into the open end of the underlying cannula and drawn down into it. The cannula is withdrawn, leaving the carrier beneath the stricture with its end presenting through the original point

of puncture. The graft, attached to a black silk ligature, is threaded on the end of the carrier (Plate I, Fig. 2). The carrier is

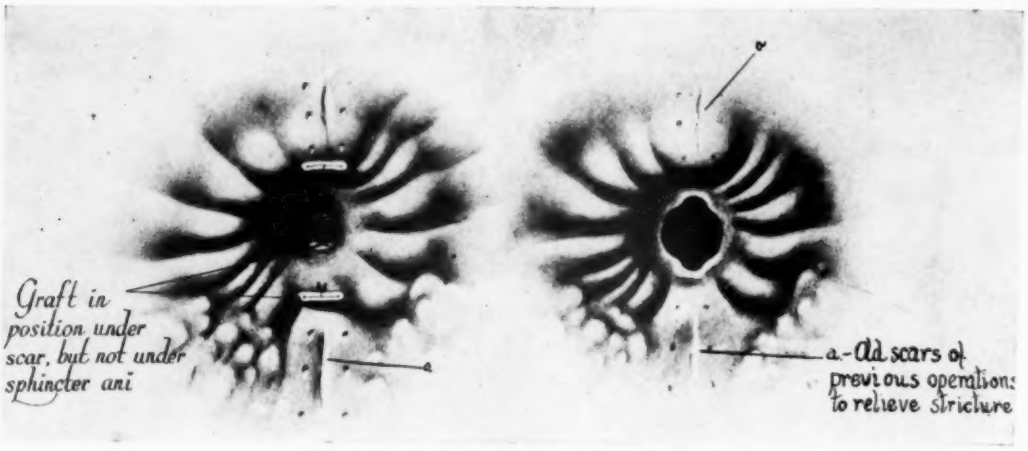

PLATE IV. Anal stricture, first stage.

passed back beneath the stricture, withdrawn from the rectum, and the ligature detached. The graft is drawn into proper

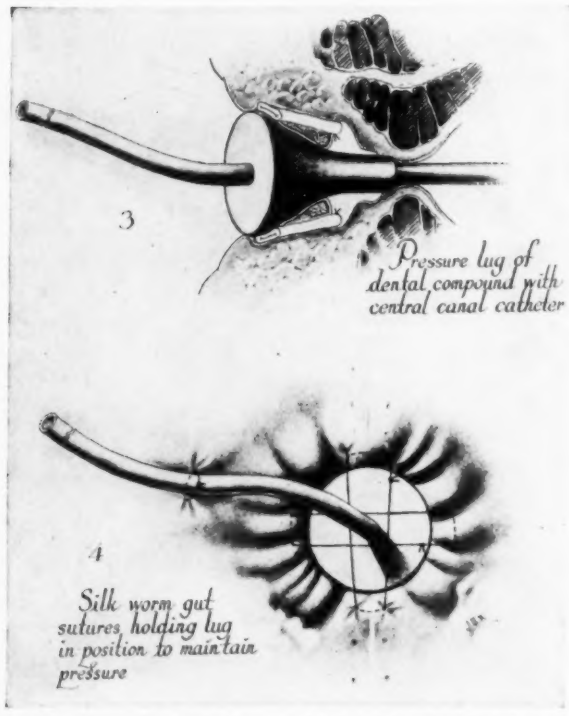
3
Pressure lug of dental compound with central canal catheter
4
Silk worm gut sutures holding lug in position to maintain pressure

PLATE V. Anal stricture, showing lug in position.

position by exerting a pull on the ligature presented through the stricture (Plate I, Fig. 3). The ligature ends are tied and allowed to remain as a marker (black thread is more readily seen) until the roof of the tunnel graft is finally removed (Plate I, Fig. 4). Usually three or four grafts are placed at equidistant points. With the grafts once in position it is imperative that there be accurate coaptation of the graft throughout the area to be epithelialized. This is to be accomplished by constant pressure with a water-distended Hagner or Pilscher bag, which not only insures proper coaptation of the opposing surfaces, but also presses out clots and secretions. In addition, it diminishes the danger of passive congestion, which usually appears about the third day.

POSTOPERATIVE TREATMENT

Precautions are taken to prevent defecation for seven days, and at the end of this period the bag is removed and the bowels freely moved. The bag is again introduced and defecation discouraged for another seven days. The bag is removed and the bowels evacuated. The rectum is cleansed with lysol irrigations. The roof of the tunnel over each graft is then divided as shown in Plate II. Irrigations with lysol or 1:500 silver nitrate solution are continued for at least one week. The end result is illustrated in Plate III.

The graft may be inserted either in tubular shape or flat, depending upon the choice of the operator. Both have been

equally successful. The thickness of the grafts used have varied from medium to full. The tubular graft is more suitable in tight strictures, because it affords a wider surface. Grafts introduced on dental compound, leaving the cavity blind at one end, have not been as successful in rectal strictures as in other parts of the body, due to the fact that infection and displacement occur more readily. They can, however, be used to advantage in anal strictures.

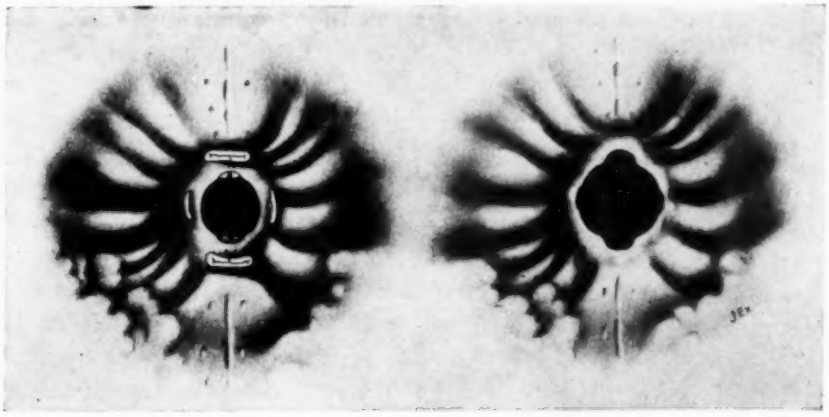

Plate vi. Anal stricture, second stage.

The U-shaped carrier, designed and used at Walter Reed General Hospital, facilitates the introduction of the skin grafts with the minimum of trauma and hemorrhage. The grafts may be introduced, however, without its use, as follows: With a small scalpel make an incision a trifle wider than the graft below the stricture; pass the scalpel under the strictured area, holding the flat surface towards the stricture; introduce the graft by passing it upward to the desired level and fixing it in position. The great trouble with this procedure is the difficulty in placing the graft accurately, holding it in position and locating the tunnel after two weeks, especially if the upper end is left blind.

The technique first used here for introducing the grafts in annular stricture of the rectum was somewhat difficult, but satisfactory, not alone in my hands, but also when used by Dr. Christian of the U. S. Public Health Service and Dr. John Finney, Jr. of Baltimore, Maryland. The technique now used and shown in the accompanying illustrations is of greater simplicity in all respects. My last case was somewhat of a departure as to type, as the stricture was 3 inches long, requiring grafts of much greater length. The results, so far, are satisfactory.

A peculiar feature of these rectal skin grafts is the fact that in some instances the growth is not limited to the original grafts, but frequently spreads over much of the surrounding mucosa. The latter factor, which might be detrimental and result in obtunding the sensibility of the rectal mucous membrane, has caused me to defer publishing this paper, even as a preliminary measure, for the past two years. In this connection I might add that a surgeon in the Southwest, who only eighteen months ago asked me for the details of this procedure, with probably the best of intentions, has recently seen fit to read, before a Proctological Society, a paper on the efficacy of this form of treatment, with less than a year's observation of the results.

In annular stricture of the anus, it is usually necessary to do the operation in two stages, as too large a graft may result in incontinence, especially in cases where a large portion of the anal sphincter has been destroyed (Plates iv and vi). It is much easier to introduce the grafts in anal stricture than in rectal, and dental compound can be used for an inlay as was done

in my first case. This patient had an anal stricture following operation at another hospital for a malignancy, and the lumen would only admit a large copper probe. Three grafts were introduced, two by the tunnel method and the third one in the form of an inlay on dental compound, similar to the Esser epithelial inlay. Regardless of the fact that the inlay graft was not entirely successful, due to infection, the two tunnel grafts did splendidly, and the result in this case was very satisfactory, and remains so after eleven years.

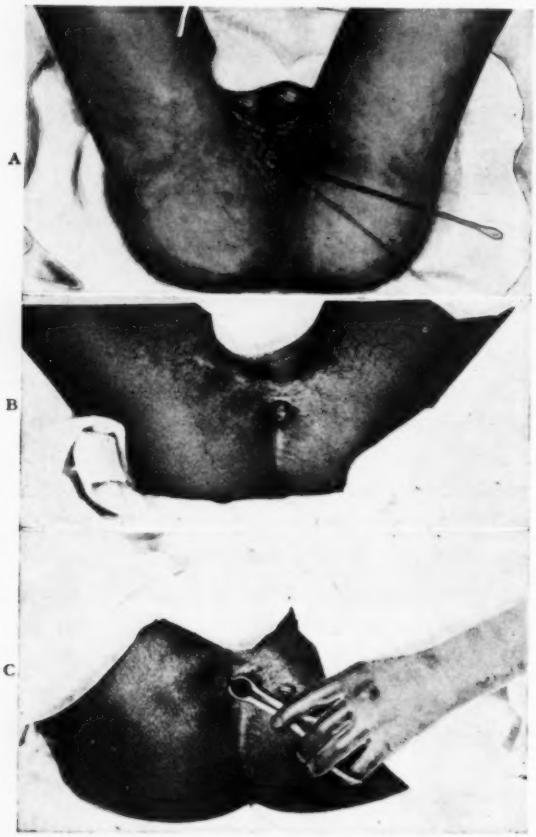

Plate vii. Anal stricture. A, before operation. B and C, photographs taken eleven years after tunnel skin graft operation.

In anal strictures a closely fitting mushroom-shaped lug, made of dental compound and perforated in the center for the passage of a catheter, has proven a very satisfactory apparatus for exerting uniform pressure on the grafts passing under the stricture (Plate v). The shank of this lug should fit the stricture tightly for the best results to be obtained. External pressure is obtained through the mushroom-shaped expansion of the lug, held in position by silkworm gut, as shown in the illustration.

In a previous paper on the tunnel skin graft,[1] I stated it is absolutely imperative that the skin for grafting must be taken from an area free from hair. I repeat this statement merely to emphasize its great importance in skin grafting in the rectum.

As stated at the beginning of this article, it is merely a preliminary report, and does not cover the subject in full. The final conclusions, which will include the results with the longer grafts, will be the subject of a future paper.

Eight cases, six rectal and two anal strictures, are included. One had the usual rectal plastics, and as a last resort had had, at another hospital, a colostomy, which we closed after the stricture was treated by skin grafting. One case was operated on over eleven years ago, and 4 cases over two years ago. All have had no further difficulty. Two cases are of only ten months' duration. In these it is too early to draw final conclusions. One case, re-reported by the pathologist to be pre-malignant, was a failure.

[1] Keller, W. L. Ten years of tunnel skin graft. *Ann. Surg.*, June, 1930.

BURNS

TREATMENT OF SHOCK AND TOXEMIA; HEALING THE WOUND; RECONSTRUCTION*

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PORTLAND, ORE.

THE first consideration in the treatment of an extensive burn is to save the patient's life, which is frequently sacrificed to shock, toxemia or blood concentration; second, to treat the wound so as to promote healing in the shortest possible time; and, third, reconstruction. They are of importance in the order named.

The burning of living tissue develops a soluble substance which when absorbed has a toxic effect on the animal organism. The immediate result of an extensive burn, however, is the production of shock; then follows toxemia. It is therefore necessary to so treat the wound that the shock and toxemia may be minimized or prevented.

When first seen the burned patient is usually in considerable pain and is rapidly going into shock. There is immediate necessity for the administration of a hypodermic injection of morphine 1/6 to 1/4 grain to an adult. Children may be given codein. The narcotic is to be repeated as may be indicated. Control of pain, application of tannic acid solution, forcing of fluids and keeping the patient warm, are the indications to be met promptly.

A great advance in the treatment of burns was the introduction by Davidson in 1925 of the application of tannic acid. When tannic acid solution is applied to burned tissues they are leatherized, tanned. The soluble protein is precipitated and changed into non-soluble protein which is not absorbed. Also the raw surfaces are covered by a firm coating which acts as a protective dressing. Tannic acid solution is easy to apply and there are no painful dressings to be done.

The local treatment of every burn should be considered an emergency as what is done in the first few hours may determine the final outcome. Tannic acid solution should be applied early.

Sterile gauze laid on the burned area should be wet with a 2.5 to 10 per cent, preferably 5 per cent, freshly prepared warm solution of tannic acid, or the tannic acid solution may be applied directly to the burned areas by means of an atomizer. In either case it should be applied every ten to fifteen minutes for the first few hours then every hour until tanning is complete, which should be within eighteen hours. Eight teaspoonfuls of tannic acid in a glass of water makes approximately a 5 per cent solution. Solutions that have stood rapidly develop gallic acid which interferes with the tanning effect. Oils and ointment already applied must be removed by solvents before the tannic acid solution can reach the tissues. Tannic acid in petrolatum or oil is far less useful than in watery solution except perhaps about the eyes. Tannic acid jelly may be used in superficial burns but is less likely to penetrate deeply.

The use of carron oil, that mixture of linseed oil and lime water so frequently used by laymen, is mentioned only to be condemned. Carron oil was justifiable in its day but now with the proved superiority of tannic acid solution it should not be used. One might argue that carron oil is always at hand and ready for instantaneous use. But why, perhaps, deny the patient his chance for life simply because an outworn treatment is readily at hand? Such reasoning does not apply to treatment of other diseases and conditions and the public should be made to recognize this.

Tannic acid may also be kept readily at hand. An ounce of tannic acid in a proper container kept dry and clean, when added

* Presented before Central Willamette Medical Society, Lebanon, Ore., June 2, 1932.

to 20 ounces of water, makes the best application for any burn.

First-aid stations may have handy quart bottles each containing an ounce of dry tannic acid with instructions on placards and on each bottle that it is to be filled two-thirds full of clean water, shaken and then applied freely to the burned area. Tannic acid dissolves readily in water and there is no delay. Certainly nothing could be simpler than this, especially when the results are so superior to those of the old oil treatments.

As soon as the burned area is completely leatherized it takes on a brown color. The dressings should then be removed and the area exposed to the air to dry, protected from injury, chilling and infection. Inclosure in a tent of sterile towels meets the indications when heated by electric light bulbs. Thus body heat is maintained and drying of the crusts promoted. The patient must be kept warm. The temperature within the tent should be maintained at 100°F. during the time added body heat is required. However, when the body temperature rises above normal the temperature within the tent should be lowered.

The importance of drying the crusts is not to be overlooked, When they remain dry the temperature, pulse, and white blood cell count early tend to become normal. When burns are deep the coagulum dries slowly and there may be some toxemia for absorption takes place wherever moisture is present. On the sixth or eighth day if the coagulum is not thoroughly dry exudate begins to form and pulse temperature and red blood cell count all become elevated and malaise and delirium appear. When any of these signs appears the leatherized tissue must be removed promptly, surgically, softening with Dakin's solution or petrolatum, if necessary.

After several days there develops an autolytic activity in the tanned tissue in the depth of the wound. This can be determined by softening and by fluctuation on slight pressure. These should be watched for and when present should indicate a prompt debridement of the area of softening and of such other tissue as can be removed without injury to surrounding parts. This may be done without anesthesia and without discomfort to the patient if a little care is used.

Following burns the temperature usually rises during the first twenty-four hours and then drops to normal or slightly above. When the crusts are properly tanned and dried the temperature stays just above normal until the crusts are off which usually is about the third or fourth day for superficial burns to about two weeks for deeper burns. The toxic stage is usually over in forty-eight hours when the tanning is started promptly.

Patients treated with tannic acid solution become very comfortable very shortly after it is applied and may lie on the coagulum with little or no discomfort. However, dependent areas must be allowed to dry by suspending the extremities when necessary.

As the result of an extensive burn there is an outpouring of body fluids and a concentration of the hemoglobin and other blood elements. It is to overcome this concentration that fluids are necessary. Fluids should be administered in considerable quantities by mouth, by rectum and by hypodermoclysis, if necessary. Frequently sufficient can be given by mouth alone. One thousand c.c. or more of fluids for every 25 pounds of body weight every twenty-four hours should be given. The necessary amount may be determined by the condition of the patient and by frequent hemoglobin estimations. Dehydration must be overcome.

The fluids administered subcutaneously or intravenously may be physiologic salt solution or 5 per cent glucose. Fruit juices and alkalies by mouth are valuable. They overcome the tendency to acidosis. Blood transfusions may be required.

However, too much fluid must not be given especially during the first three days as during this time the kidney secretion is diminished due to edema of these organs.

After the third day the amount of urinary secretion usually increases and there is no permanent renal damage.

To simply order "force fluids" is not definite enough instructions for the nurse to follow. Indicate definitely the amount to be given by mouth and otherwise. The daily intake and output of fluids should be accurately measured and recorded.

Fluids must not be forced in every burn case. In the patient who has inhaled flame, edema of the glottis must be looked for. In extensive body burns with injury to the glottis one must delicately weigh the conditions. When the body burn is small and the flame has been inhaled the patient should be dehydrated by giving 25 c.c. of 50 per cent glucose intravenously, or an ounce of concentrated solution of magnesium sulphate by rectum. Also one must be ready to do a tracheotomy if necessary. The edema of the glottis may be the death-dealing complication if not watched for.

Throughout the treatment of the burn the patient must not be forgotten. It is useless to treat the wound with perfect technique while the patient is dying of shock, the effect of blood concentration or a heart condition.

Deaths that occur within twenty-four hours are due usually to the enormous area of skin burned which overwhelms the patient. During the second twenty-four hours the number of deaths has been markedly reduced since tannic acid has been used. The late deaths have also been markedly reduced due to the control of infection and septic complications.

Glover, reciting his own results and those of other surgeons, gives figures which show an average death rate of 13.1 per cent following tannic acid treatment. In his own series of 310 cases treated in six years the death rate was 9.6 per cent. No cases treated by this method were lost on the sixth day or later following the burn and in the earlier days the death rate was considerable below those treated by other methods except the deaths which occurred on the first day.

The extent and depth of a burn cannot always be determined at the outset and it is therefore important to see that the tannic acid solution reaches into the deep layers. Blebs should be punctured and the skin forming them taken away promptly. Foreign material should be removed without added trauma.

The pathology resulting from burns is found principally in the liver and spleen. There is fatty degeneration of the liver with an accumulation of degenerating white cells in the capillaries causing a circulatory leucopenia. The spleen is overfilled with epithelial cells and nuclear debris. Some autopsies show degeneration of the adrenals. Early the kidney elements are swollen and the urinary output is depressed but no permanent kidney injury is found when recovery takes place.

Cardiac deaths may occur on the fourth or fifth day, or earlier. The heart, therefore, should be carefully watched, especially where a heart lesion existed before the accident. Supportive measures may be indicated throughout. The cardiac deaths which occur on the fourth or fifth day are similar to the late cardiac deaths of diphtheria. Apathy, pallor, rising pulse rate, intervals of bradycardia, heart irregularity, vomiting, pulmonary edema precede coma and death. These are the patients who probably would not have lived long enough to show these changes in the days before tannic acid treatment was used.

Late complications of burns may be peptic ulcers, acute colangitis, acute cystitis, acute polyarthritis, peripheral neuritis, retinitis, and other conditions resulting from local sepsis.

As soon as the coagulum is off everything possible should be done to promote epithelization so as to prevent the profound secondary anemia which so often develops. As a general rule skin grafting should be done promptly where large areas are devoid of epithelium.

Epithelization is influenced very little by the tannic acid treatment but through

its use secondary infection is less likely to delay healing.

In second degree burns the crusts often may be left on until displaced by the new epithelium growing beneath.

Every effort must be made to avoid scar contractions by applying splints where necessary and hyperextension.

There are a great many methods of treating wounds and it is not within the province of this paper to discuss them all. Paraffin gauze, warm paraffin, various chlorine antiseptics and ointments of boric acid and of balsam of Peru are useful at times, as are moist dressings of physiologic salt solution and magnesium sulphate, and innumerable others.

Scarlet R ointment alone has been used for a long period. However, the results obtained from its use are not completely satisfactory, for while the growth of epithelium is stimulated, infection acts as a deterrant. By the addition of oxyquinoline sulphate, chinosol, a powerful antiseptic, the infection is held in check while growth of epithelium is promoted. The addition of chloretone makes the dressing soothing and the usual result is for patients who have suffered considerable pain to become comfortable in a few minutes after the application of this dressing.

The method found most satisfactory is by the use of what I have designated as oxyquinoline sulphate scarlet R gauze. The formula is as follows:

Oxyquinoline sulphate (Chinosol)	Grs. x
Trichlortertiarybutyl alcohol (Chloretone)	Grs. xl
Scarlet R ointment 5 per cent	Ozs. iv
Liquid petrolatum	Dr. i

The chinosol and chloretone are separately mixed with portions of the liquid petrolatum. These are then added to the scarlet R ointment until a smooth ointment results. This ointment is then heated in a water bath and rolled gauze bandages are immersed in it until thoroughly impregnated. The warp and woof absorb the ointment but the interstices are open.

In the treatment of a burn or other wound with oxyquinoline sulphate scarlet R gauze a single layer is laid over the wound, dry dressings are laid over it and held with a bandage so that the medicated gauze is in intimate contact with the entire wound surface. Secretions seep up through the mesh and are carried away by the gauze. The superficial dressings are changed every second or third day and the red gauze as may be necessary. When the oxyquinoline sulphate scarlet R gauze adheres to the wound it is never pulled off. Where it is floated up by secretion or is not adherent, the result of complete healing, it is removed and new gauze is reapplied to all unhealed areas as before. It is remarkable how quickly healing takes place under this ointment and technique. Complete details have been published.[6]

The oxyquinoline sulphate scarlet R gauze may be used with advantage to prepare areas for Thiersch and other grafts, and also as a dressing over grafts. This dressing on grafts is not changed for six to eight days unless there are special indications for changing, and they are applied in the same manner as for healing wounds.

Frequently the epithelization of wound edges may be hastened by the application of narrow strips of adhesive plaster parallel to the edges in such a manner that half the width covers the skin and the other half the ulcerated area. This adhesive plaster, of course, must be sterilized by flaming. The oxyquinoline sulphate scarlet R gauze is then laid over the wound and the adhesive plaster and it is changed every third day. The application of the adhesive plaster tends to prevent the turning in of the skin edges and the overgrowth of granulations. It holds the two surfaces level and the advancement of the epithelium is hastened considerably.

The reconstruction of scars and conditions resulting from burns involves the whole subject of plastic surgery. Individual cases may require anything from simple Thiersch grafting to the most extensive reconstructive procedures. To cover all

these satisfactorily is more than can be done in the space allotted. However, it should be stated that whenever plastic surgery is undertaken two conditions are of primary importance. First, treat the tissues kindly, and, second, bring the edges into exact apposition.

Scars, the result of burns may be excised and resutured or replaced by grafts, either Thiersch, full-thickness or pedicled depending on the conditions to be met and the location. Thiersch grafts are probably the easiest to apply but give the poorest cosmetic result. They have a tendency to contract and are off-color.

Autografts are best but grafts from other individuals, homografts, may take but usually they disappear in about two weeks. It is probably never justifiable to apply them except to carry a patient over a crisis. During the days that the foreign skin remains the patient may be built up and then skin may be grafted from his own tissues.

Old burn scars may undergo chronic infection and not a few become carcinomatous. The removal of extensive burn scars and loosening binding contractions about articulations requires a great deal of cooperation on the part of the patient and most careful planning and persistence on the part of the surgeon.

The result of releasing binding scars is greater comfort to the patient and in many cases better appearance and improved function. It may mean freedom to the one who is grown to himself in an awkward, crippled and grotesque position.

Thiersch grafts are not applicable to flexor surfaces such as the axilla, the neck, the elbow, or the popliteal space, on account of the contractions which result. Pedicled grafts are best in these regions. Delayed or tubed they are useful and render valuable services in many areas.

Wolfe grafts must contain no fat on the under surface and their bed must be dry. They require to be placed with some tension and firm but not heavy pressure. They must be held absolutely immobile until the blood supply has developed. Sea sponges or rubber sponges may be used for pressure and to immobilize them.

The use of full-thickness grafts applied on a Stent are very valuable in selected locations. In fact, it is by this means alone that the large grafts may be applied to certain locations as about the eyelid.

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TANNIC ACID

ITS USE IN THE TREATMENT OF ABRASIONS AND ALLIED CONDITIONS

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THE uses of tannic acid preparations as suggested in this paper are not advanced as original, but merely to call attention to some of the possibilities other than in the treatment of burns.

Tannic acid in solutions of from 1 to 10 per cent have been used rather extensively, since the work of Davidson, in the treatment of burns with gratifying results. Inasmuch as superficial abrasions, brush burns and in fact any denuded area basically resemble the tissue lesion produced by a burn, the utilization of tannic acid in their treatment seems quite logical.

It may be well to briefly summarize those properties of tannic acid as applied to treatment of the lesions under discussion. Tannic acid is an astringent and an antiseptic by virtue of its protein coagulating properties. It unites with devitalized tissue to form a complex protein tannate, which action is resisted by normal tissues. The result of the process is a tanning of the traumatized area, which forms a hard, aseptic, leathery, brown to mahogany brown crust, adapted solely to the lesion. The advantages of this crust formation are as follows:

(1) It protects the lesion from bacterial invasion.

(2) It protects the lesion from external irritants (thermal, mechanical, etc.) by covering the sensitive nerve endings, thereby assuring a maximum of comfort to the patient.

(3) By adapting itself directly to the wound, it obliterates dead space (applying the principle of pressure to the treatment of wounds) thus reducing exudation to a minimum. In this way it eliminates moist granulations and obviates to some extent the distressing complications (infected granulations, cellulitis, etc.), which not infrequently follow a lesion of this nature.

(4) It tends to prevent exuberant granulations and serves as a protective covering for the young granulating tissue and the new epithelium, which forms under it during the process of repair.

(5) It produces practically no tissue damage and reduces scar formation to a minimum.

(6) It has an obvious advantage over messy ointments, which usually macerate tissue and favor infection.

From the foregoing statements, the rationale of this treatment for abrasions and similar lesions seems to have as firm a foundation as it does in the treatment of burns.

Tannic acid can be applied as an aqueous solution, or in the form of amertan, which is composed of 5 per cent tannic acid and 1–5000 merthiolate (an organo-mercury germicide) in a water soluble jelly base. The advantages of the latter may be listed as follows:

(1) Amertan is easily accessible and stable in contradistinction to solutions of tannic acid, which rapidly change to gallic acid, therefore making it necessary to prepare fresh solutions frequently, thus causing delay in treatment when not directly at hand.

(2) It is applied with ease and usually one application suffices, whereas with the aqueous solution, the lesion must be continually moistened to obtain the desired effect.

(3) Amertan contains merthiolate, which further enhances the antiseptic action of the tannic acid.

The types of lesion which are best treated by this method are superficial abrasions, lacerations, brush burns, and shallow, slow healing ulcers. It can also

be used to great advantage in covering the matrix after the removal of a nail from the finger or toe. The crust renders the lesion insensitive and prevents infection.

The preliminary treatment is the same as that used ordinarily in lesions of this character. The injured area should first be thoroughly cleansed by any of a number of methods, i.e. soap and water, alcohol, ether, benzine, etc. Some men like to irradiate the area with the cold quartz light as a further preventative to infection and as conducive to faster healing. Following this, the tannic acid is then applied. If the aqueous solution is used, a 2.5–5 per cent solution gives the best results. It can be applied either by spraying it on the wound directly by means of an atomizer or by first saturating a dressing. This method, as previously stated, necessitates frequent reapplication of the solution.

If amertan is selected, a rather thick coating (about ½ inch in depth) can be applied directly to the wound by means of a sterile tongue depressor, or first to several layers of gauze. The latter method is slightly more advantageous, because of facility in handling and more even distribution. A loose bandage is then placed.

Tanning is usually complete in twenty-four hours, although it sometimes takes forty-eight hours. The wound can be inspected on the next day and additional amertan applied to any untanned areas. If the dressing has a tendency to adhere, it can be removed by moistening with normal saline solution or hydrogen peroxide. From the time tanning is complete treatment consists only of inspecting the wound for signs of suppuration and changing the dressing as indicated. No attempt should be made to remove the coagulum since it tends to loosen spontaneously. Premature removal only defeats the purpose of the treatment and causes unnecessary annoyance to the patient. The only indication for removal is infection, which will be taken up shortly.

In very superficial lesions the crust loosens in from four to seven days, because of leucocytic action and epithelization takes place beneath; the crust loosening at the edges as healing progresses. The free edges can easily be cut away as indicated. In deeper lesions the process takes a little longer and if epithelization is not complete it leaves a clean, smooth granulating surface.

Inasmuch as tannic acid is somewhat antiseptic, infection is ordinarily kept at a minimum, if ordinary surgical principles are adhered to at the onset, i.e. attempted sterilization of the wound and aseptic technique. If infection does occur, it can usually be recognized by loosening of the crust over that area. Treatment then consists of softening the crust with liquid petrolatum, cutting away the portion over the infected area and treating it as an infected wound. This suppuration should not be confused with the formation of a slight accumulation of serum under the crust, which sometimes takes place in the process of repair. The remaining crust serves as a barrier against infection of the whole area. Wet dressings should not be used in combination with the coagulum except in case of infection.

CONCLUSIONS

1. Tannic acid, especially in the form of amertan, approaches the ideal method for the treatment of superficial abrasions and allied conditions.
2. It lessens the incidence of infection.
3. It affords a maximum of comfort to the patient.
4. It is conducive to healing.
5. It minimizes scar formation.
6. It is preferable to ointments.

PYELOGRAPHY IN INJURIES TO THE KIDNEY

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INJURIES to the kidney producing various degrees of damage to the parenchyma, calices and pelvis may present radiographic and pyelographic findings that are of interest and of diagnostic and prognostic importance.

The perirenal hematoma usually associated with the injury will result in some degree of fibrosis about the kidney. In some cases, as a result of secondary infection and the organization of the hematoma, marked chronic perinephritis may be the sequel.

The pulpification and destruction of a portion of the kidney, resulting in fibrosis of this portion or of the entire kidney, will give pyelographic evidence both early and late which is of importance.

As a result of injuries to the calices, pelvis and ureter, varying degrees of hydronephrosis may occur.

Adhesions and bands about the ureter and pelvis may produce kinking and distortion of these structures. Stricture of the ureter with resultant hydronephrosis may occur. The very commonly associated

FIG. 1.

FIG. 2.

FIG. 1. Rupture of one of calices due to overdistention in retrograde pyelography, presenting a picture quite different from that which has been described as pyelovenous backflow. In past, when collargol was medium employed, extravasation of collargol into parenchyma of kidney, as in pyelogram shown here, caused occasionally an absorption into general circulation, embolism and sometimes death. This also represents a type of renal injury from simple pyelography. In some cases injury to calices may result from pushing catheter too forcefully and too far up into pelvis. I have demonstrated to myself on postmortem specimens that somewhat semi-rigid ureteral catheter inserted into pelvis can produce considerable trauma.

FIG. 2. Pyelogram of patient with a gunshot wound of kidney who made an uneventful recovery. In this injury kidney alone was damaged. Separation and injury to lower calix, where bullet had passed, is well shown.

pyelonephritis which may become chronic will cause further damage.

The various pathologic changes give pyelographic evidence both early and late; in some of the cases shown here the picture is clear and illuminating.

Fig. 3.

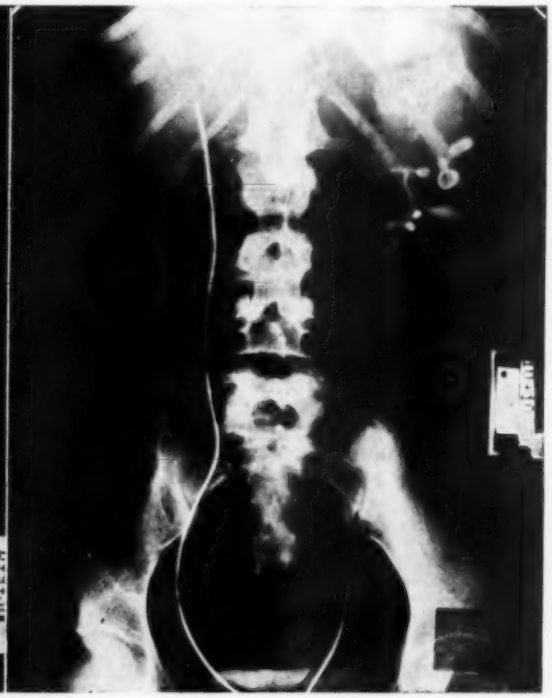

Fig. 4.

Fig. 3. Flat plate. Another type of ruptured kidney: spontaneous rupture of calculus hydronephrosis and pyonephrosis. There is obscuration of psoas shadow of that side together with shadow of large extravasated pus and urine which was diagnosed preoperatively as simple perinephritic abscess.

Fig. 4. Retrograde pyelogram showing large cavity in kidney filled with contrast fluid with marked compression of calices. This represents cavitation in caseocavernous tuberculosis of kidney and is not traumatic. This is shown here merely because it may be mistaken for rupture of the kidney.

The various types of injuries to the kidney are shown in Figure 5. The original classification into ecchymoses, subcapsular and transcapsular injuries is still the best. The milder forms of injuries produces ecchymosis in the cortex and parenchyma of kidney only and clear up without any permanent damage to the kidney. They give no pyelographic findings. In the subcapsular form the kidney may be almost pulpified with the fatty capsule still intact and no open injury in the skin; the injury is subcutaneous. These comprise the vast majority of cases. In the transcapsular form the injury is still subcutaneous but the fatty capsule is torn and a marked hematoma usually forms within a few days.

These injuries usually result from trauma to the loin in various types of accidents. Direct injuries, such as gunshot or stab wounds, are also seen, one of which is pictured here (Fig. 2).

I have also included in this series a pyelogram of what has been described as pyelovenous backflow but is in many cases an actual rupture of a calix as the result of overdistention in pyelography (Fig. 1).

Another type of injury, spontaneous rupture of a previously diseased kidney, is also shown (Fig. 3).

Injuries to the kidney are relatively infrequent. A review of the cases from the records of the Cook County Hospital[1]

[1] Rolnick, H. C. *Illinois M. J.*, July, 1931.

published by me showed its incidence as one in every 3000 admissions.

The material for this paper is based upon

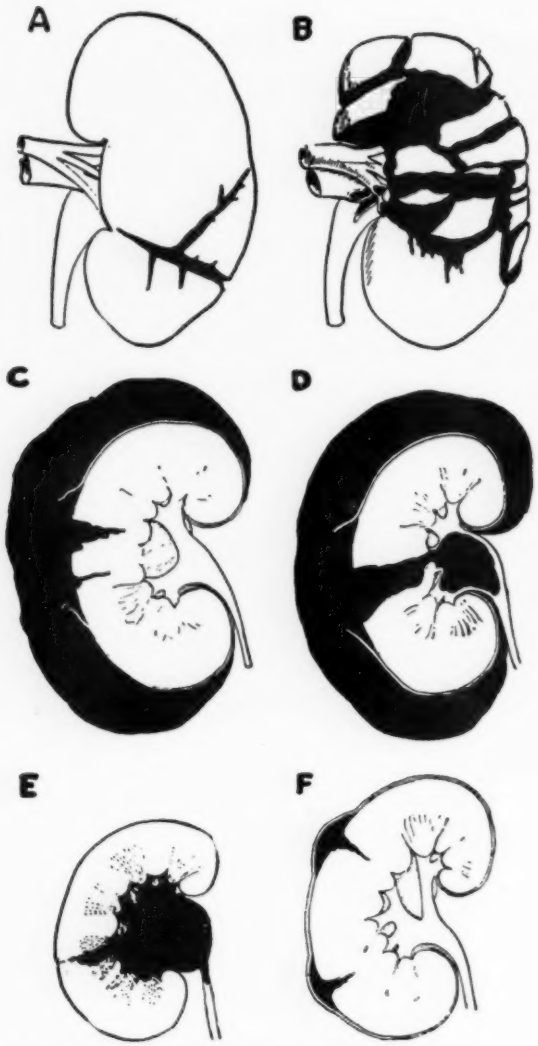

Fig. 5. Diagrammatic representation of various degrees of injury of kidney. (After Papin.)

A. Fissured rupture involving only lower pole.
B. Almost complete destruction of kidney involving large vessels at pedicle.
C. Small laceration of cortex but large perinephritic hematoma.
D. Same as C but extending into renal pelvis.
E. Marked accumulation of blood in pelvis from relatively slight injury of parenchyma.
F. Subcapsular tears with localized hematoma.

a series of 10 cases observed and treated by me at the Cook County Hospital during the last three years. The pyelograms here shown are of cases under my observation.

The value of radiography in the early diagnosis of renal injuries is limited. The history of injury, evidence of external trauma and hematuria establish the diagnosis. The patients are usually brought to the hospital suffering with some degree of shock, together with injuries to the ribs or pelvis, and very early develop "renal ileus" with distention of the bowel. All this makes a simple radiogram of little value.

In the transcapsular ruptures with a swelling in the loin due to a hematoma there may be radiographically a distortion of the renal shadow and obscuration of the psoas muscle, if this is not itself obscured by the distended bowel.

The clinician must, therefore, depend in the main upon clinical evidence for the early diagnosis of renal injuries and the extent of the injury in recent cases. It is often difficult to determine whether there is associated injury of the intraperitoneal viscera. As a rule these patients die within a few hours after reaching the hospital.

The reflex peritonitis, of which the ileus is one manifestation, makes the differential diagnosis between an intraperitoneal involvement and injury to the kidney difficult. In some casses the marked ileus with distention of the stomach that accompanies the severe injuries often gives the impression of associated intraperitoneal involvement. There are a number of reports of retroperitoneal hematoma secondary to renal injury mistakenly diagnosed as peritonitis and operated upon.

The best treatment for traumatic lesions of the kidney is conservative non-operative treatment, except in those cases where the injury is very extensive. Marked exsanguination, the development of a large hematoma or evidence of secondary infection call for operative interference.

In this series only injuries limited to the kidney were studied. All those patients with associated injuries, usually extensive, to the other viscera died before reaching the urologic service.

If the diagnosis is in doubt, cystoscopy will show bleeding from one ureteral orifice. Ureteral catheterization and pyelography

in the presence of hematuria from a recent injury of a few days' duration carries with it the danger of further damage to the shadow which does not give a true picture of the pathology present. Our experience with intravenous pyelography is limited

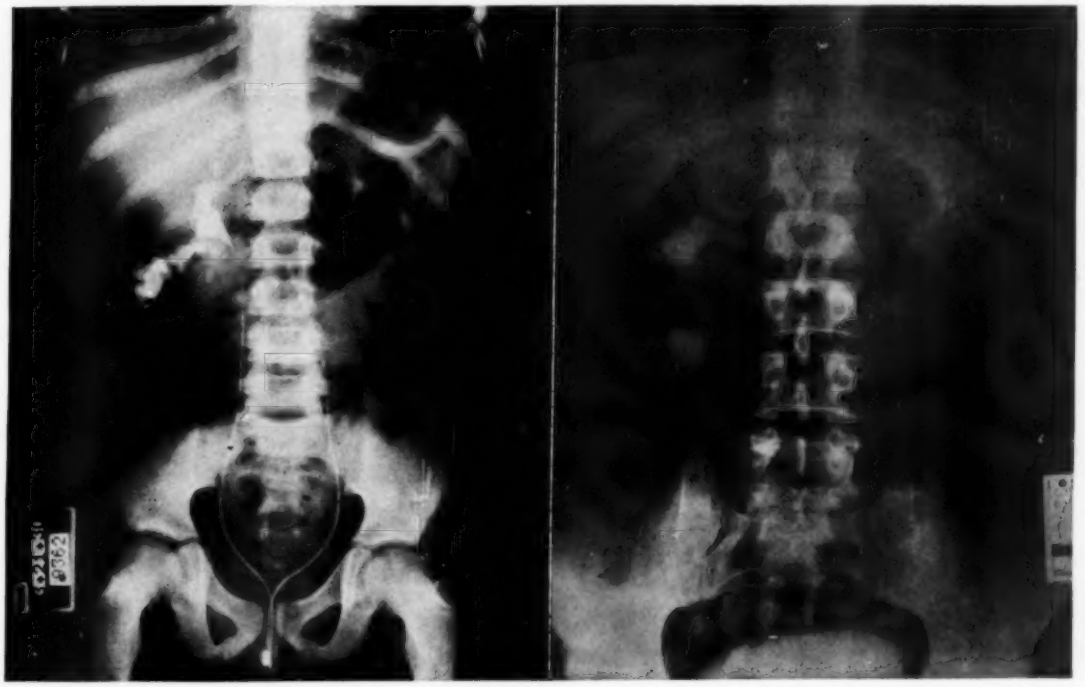

Fig. 6. Fig. 7.

Fig. 6. Retrograde pyelography of subcutaneous and subcapsular injury to kidney in boy of twelve who had fallen off a wagon. Pyelogram made two weeks after injury when patient had practically completely recovered shows marked damage to lower pole, probably pulpification of that portion of kidney. Unfortunately this patient was not studied further but most likely this portion of kidney has become fibrosed.

Fig. 7. Intravenous pyelogram of severe injury to right kidney. This patient had marked ileus. Question of intraperitoneal involvement was debated but ruled out by eliciting intestinal peristalsis and also fact that general appearance of patient was good. This pyelogram, taken two weeks after recovery following conservative nonoperative treatment, shows marked hydronephrosis, distortion of outline of calices. Value of intravenous pyelography is clearly shown.

kidney and increasing the hematuria. If the bleeding ceases within a few days, ureteral catheterization at this time may cause resumption of the hematuria. Above all, the greatest danger at this time is secondary infection. There is also the danger of embolism resulting from pyelography in a recently damaged kidney.

Pyelography is of very little value in the presence of active bleeding. The contrast medium injected through the ureteral catheter will be obscured by the free and clotted blood in the pelvis and calices and either give no roentgenographic shadow or a distortion of the pyelographic

to one case (Fig. 7) in which the pyelogram was made fourteen days after the injury with the patient practically recovered. It is possible that intravenous pyelography may be of aid in the early diagnosis of renal injury.

Here also, however, we have the various conditions to meet with which will most likely make this procedure of little value and possibly of some danger in early cases. The patient is suffering from shock; there is oliguria, diminution of the urinary secretion, the injured portion of the kidney does not secrete urine and for a period of twenty-four to ninety-six hours there may

be limited secretion from that side. The presence of blood in the pelvis and distention of the bowel will obscure the shadow. However, absence of a pyelographic shadow from the injured side will indicate at least the side of the injury.

Intravenous pyelography will, however, replace retrograde pyelography for the diagnosis of the extent of injury and associated pathology when the hematuria has ceased and the patient has been relieved of his acute symptoms. Ureteral catheterization and retrograde pyelography, even after hematuria has cleared up, still carries with it the danger of infection.

Fig. 8.

Fig. 9.

Fig. 8. Later results of extensive traumatic injury to kidney. Retrograde pyelogram three months later shows filling defect and is almost indistinguishable from that seen in renal tumor. Calices have been torn, replaced by fibrous tissue and there is evidently a marked perinephritis.

Fig. 9. Bilateral retrograde pyelogram one year after injury. Patient was operated upon for persistent pain and some pyuria on injured side. Here also pyelographic picture simulates that of filling defect seen in renal tumor. In this case perirenal fibrosis was marked, perirenal tissue had a shoe-leather hardness which was freed with considerable difficulty. Amount of perirenal sclerosis seen even early is very marked. In one patient operated upon six weeks after injury, perirenal capsule was almost 1 inch thick. Picture here presents marked perirenal fibrosis and compression of kidney.

PRIMARY ACUTE EPIPLOITIS*

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PRIMARY acute epiploitis is an inflammatory pseudo-tumor of the omentum, to all appearances not connected with any demonstrable intraperitoneal pathology at the time of exploration. Both French and German literature speak of epiploitis when dealing with inflammatory processes of the omentum, and we found no description of this entity under the name omentitis. Epiploon is the Greek synonym of the Latin omentum and, as in the case of appendicitis, omentitis would be a hybrid term, coupling a Greek suffix with a Latin word.

The condition was first observed by Lucas Championière[1] in 1892 in connection with herniotomies, in which the omental mass was either found in an old hernial sac, or developed within a short time of the operation. He found 2 cases of epiploitis in a series of 275 herniotomies. The observation of Lucas Championière stimulated a number of subsequent reports in the French literature by Reynier, Sauget, Morestin, Forgue, Monod, Walther, and others. Péan,[2] on the other hand, failed to find omental tumors other than cysts, lipoma, tuberculosis and carcinoma. In the German literature, there are three important publications, viz: that of J. Schnitzler,[3] who collected all the cases prior to 1900 and added a few cases of his own, bringing the total number to 24; that of H. Braun,[4] who added 8 cases, and that of D. G. Zessas,[5] who was able to collect 44 cases.

In the light of the protective ability of the omentum by way of absorption and bactericidal power, it is somewhat confusing that the omentum itself should fall victim to infection. There is considerable controversy concerning the "intelligent mobility" of the omentum and its migration toward inflammatory areas. Several physiologists deny such active mobility and explain omental displacements by passive movements of the body, intestinal peristalsis and diaphragmatic excursions. Goldschmid and Schloss,[6] Vaughan,[7] and Buxton and Torey,[8] who studied the absorptive and bactericidal power of the omentum, failed to prove automotive or ameboid movements, or negative or positive chemotaxis. Arnaud[9] credits the omentum with several definite functions: it fixes microscopic bodies, it surrounds large immobile foreign bodies, it possesses so-called "intelligent mobility," it has secretory powers, it regulates the isotonicity and maintains the sterility of the peritoneal cavity. In a discussion in Queries and Minor Notes,[10] it is stated that the engulfing of foreign bodies by the omentum and its attachment to inflamed areas is simply due to "production of a layer of fibrin at the point of contact." It is further stated that the omentum has greater power of exudation and fibrin production than the peritoneum, which also applies to the bactericidal, phagocytic, and tryptic activity. It is quite definitely established that omental excursions are passive and that its adhesive properties are due to exudation.

The omentum under discussion is the great omentum, one of the three omenta, viz: the gastrocolic (great omentum), the gastrohepatic (lesser omentum) and the gastrosplenic.

In the French literature, the etiology is charged to ligation of omental flaps with silk, chiefly in connection with hernia operations. While H. Braun[4] does not deny this etiology, he observed epiploitis after hernia operations when catgut was used. As a matter of fact, fragments of both catgut and silk were found in old necrotic

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omental stumps. He considers manipulation of the inflamed omentum of primary importance, irrespective of the type of suture material used. In a discussion at the Paris Society of Surgery, C. Monod[11] blamed silk in ligations of the omentum and recommends catgut instead. J. Schnitzler[3] traces the origin of epiploitis to the incomplete ligation of an inflamed omental segment with silk. E. Holländer expressed precisely the same view, before the Berlin Society of Surgery, March 10, 1913, on the ground that it does not completely necrotize omental stumps but merely causes hemostasis. He, therefore, suggested individual ligation of blood vessels instead of ligation en masse. Küttner[12] suspects that in some cases, the suture material may not have been sufficiently sterilized; also, that ligation of inflamed omental segments may go on to a more extensive infection.

As a rule, epiploitis follows resection of bulky and adherent omentum in old hernias. However, epiploitis may exist independently of resection of the omentum. In a case of H. Braun, an operation for incarcerated femoral hernia, in which there was no omentum in the sac, was followed eleven weeks later by an inflammatory omental mass, 15 cm. in diameter.

Epiploitis occurs most commonly in middle-aged individuals usually among fat people, and in most cases follows a previous abdominal section or herniotomy.

The source of the inflammation may vary. Schmieden[13] ascribes epiploitis to circulatory disturbances, either thrombosis, embolism, hemorrhages, or torsion of the omentum, sufficient to cause pathologic changes but not death of the tissues. Adams'[14] case was secondary to "no detectable abdominal lesion" and concludes that it was "probably embolic." Pantzer[15] considers epiploitis haematogenous in origin. He states that ordinarily bacteria undergo hemolytic destruction in the omentum, "without leaving any anatomic trace of their visitation on the tissue of the omentum." If this process does not take place, omental infection ensues.

While it is generally agreed that the contamination of the omentum is secondary to diffuse or localized peritonitis, or pathology of individual intraperitoneal organs, in a few cases, including our own, there was no other gross pathology at the time of the operation. It could be argued that in such case the original pathology subsided and that the omental mass detached itself from an old lesion. Such must have been the case in a patient of Walther,[16] in which the omental tumor followed a definite attack of appendicitis, at the time of the operation, however, the mass was free from the appendix. Walther characterizes this situation as pathology "*à distance.*" Pantzer is of the opinion that mere agglutination of the omentum to an inflamed segment does not signify pathology of the respective segment, as it may be perfectly normal after detachment. The case of Heinrich Schoemberg[17] was to all intent and purpose primary, and he states that "until now [1929] an idiopathic epiploitis has not been established." Walther reported several cases in which there was no gross pathology in the peritoneal cavity outside of the omentum.

Etiologically speaking, then, epiploitis follows, in most cases, herniotomies and abdominal operations, in which the omentum is the only demonstrable pathology, or in which contamination takes place from an adjacent pathological organ, such as appendix, gall bladder, intestine and, less frequently, an inflammatory process in the pelvis. Exceptionally, the omentum becomes infected from without, as in the case of W. Steiger[18] in which the omentum became infected from a perforated intestine secondary to a stab wound. H. K. Sowles.[19] reported a case of omental abscess after a blow to the abdomen, the abscess being agglutinated to the structures at the site of the injury. Müller[20] described an omental tumor attached to an ovarian cyst. Hadra[21] reported 2 cases: one in connection with a chronic salpingitis, the other with a perforated uterus, in which the omentum sealed the perforation. The

principal reason for the scarcity of inflammatory tumors of the omentum in the pelvis is due to the fact that the omental apron is, in the majority of cases, insufficiently long to reach it.

The omental tumor develops either shortly or as late as two or three years after an operation. In Braun's collection of 22 cases, the symptoms appeared from four weeks to three years after the patient left the hospital. Boeckel's[22] patient developed a mass three years after a herniotomy.

Pathologically, the inflammatory changes in the omentum may be classified as plastic, suppurative and chronic. The tumor mass varies in size from that of an orange to that of a fist or grapefruit; occasionally, the entire omentum is infiltrated. Such cases were reported by Lucas Championière and C. B. Maunsell.[23] In the former case, the entire omentum was an indurated mass secondary to chronic epiploitis in an old inguinal hernia. The latter, a case of Maunsell, was a soldier who suffered from dysentery during the World War and presented symptoms of subacute ileus. At operation, the entire abdominal cavity was occupied by a massive plate of omentum which required bowel resection. The size of the mass depends upon whether or not the process is limited to the omentum or it takes in a neighboring organ, which augments its original size. If it follows herniotomies, the mass is found in the vicinity of Poupart's ligament; otherwise, it may be found in the region of the umbilicus, ribs, and less commonly in the pelvis, but practically always in the area of the original operation.

The omental pseudo-tumor is either smooth or irregular, doughy in consistency; it is either free or agglutinated to some viscus or to the abdominal wall. Pantzer speaks of "indefinite tumefaction." The mass may show active signs of acute inflammation or, in about one-fourth of the cases, go on to abscess formation, usually single, occasionally multiple. The acute suppurative cases may perforate spontaneously into a hollow viscus, such as intestine, gall bladder, urinary bladder, or even through the abdominal wall. If such be the case, the discharging pus contains fragments of silk or catgut, or omental oil, all of which is suggestive of its origin. In the French literature, there are a few cases reported of a persistent sinus following spontaneous rupture through the abdominal wall with silk at the bottom of the sinus. The omental mass may interfere with the function of the organ to which it is agglutinated, even to the point of obstruction. It may be so intimately connected with an abdominal organ that its detachment is technically impossible, without causing considerable anatomic damage, and it may require the extirpation of both omentum and organ en masse. Silas Lindquist[24] reported 3 cases of epiploitis producing symptoms of ileus, all three requiring intestinal surgery. In a case of Schmieden, the omental mass was so intimately attached to the cecum and ascending colon that resection was impossible; the mass was not disturbed and the obstruction was shortcircuited by anastomosing the ileum to the transverse colon, after which the omental tumor receded.

The tumor mass may lead a chronic existence, or, as stated, may suppurate and give rise to local or general peritonitis; it may perforate, and terminate in general sepsis; it may bleed, recede or completely disappear. A case of Boeckel simulated malignancy, because of the presence of tumor and cachexia; ultimately, however, the mass disappeared without surgery. In Braun's series, 14 out of 30 cases disappeared without operation. Whenever epiploitis is associated with pathology of another organ, appendix, gall bladder, duodenum or colon, etc., it shares the chronicity of the respective organ.

Bacteriologically, the omental abscess may reveal: Staphylococcus albus, streptococcus, colon bacillus, occasionally tubercle bacillus and, exceptionally, may show evidence of lues. A case of luetic epiploitis is reported by Armstrong Bowes,[25] the

granuloma compressing the colon to the point of obstruction.

The earliest suggestion of epiploitis is the presence of localized or colicky pain and a sense of resistance at the site of a previous operation, within two to six weeks after surgical interference. In the beginning, the condition may express itself in terms of light dyspeptic symptoms. As time goes on, the pains become severe and more lasting and may be associated with signs and symptoms of peritoneal irritation, such as nausea, vomiting, hiccough and meteorism. There may be paroxysms of abdominal pain associated with chills and fever. A clinical paradox is mentonedi by Prutz and Monier[26]: the earlier the symptoms, the more diffuse the process, the later, the more circumscribed the tumor. As stated, the pain is usually in the area of the original operation, but if the mass is large it may displace itself, in which case the pain moves with the tumor and may cross the median line and go to the other side. The tumor is, as a rule, mobile and may be displaced upward, sideward, but never downward. If it is attached to the abdominal wall, the mass is fixed. The tumor is not affected by respiratory movements. The percussion note over the mass is always dull, since the bowels are always behind. Physical exercise may bring about pain, especially if the mass is adherent to the parietal peritoneum.

CASE HISTORY

Mrs. B. A., aged forty-six, married.

Past History. Patient states that she has always been well, except for an attack of "bronchitis" about twenty years ago. She was then confined to bed for two months. Her physician suspected that she had pulmonary tuberculosis, but there has been no confirmation of this diagnosis. She has had no bronchitis since the former attack. She was never subjected to surgery prior to the present operation. Otherwise, the past history is essentially negative. Her menstruation was normal and ceased completely one and a half years ago.

Present Complaint. Two years ago, she was suddenly seized with severe abdominal pains, which were quite severe, colicky in character and were diffuse over the entire abdomen. She was taken to a hospital at night, where she remained for two days. The abdominal pains subsided after forty-eight hours, and the patient states that no definite diagnosis was made at the time. She has had since several paroxysms of abdominal pains of a similar character at intervals of two or three months, lasting one to two days. Once, she had severe pains in McBurney's zone which was diagnosed appendicitis. At that time, she states that the right side of the abdomen "was higher than the left." She has had no chills, fever, nausea or vomiting during any of these attacks. Prior to her entrance in the hospital under our care, she was ill in bed for two days with very severe abdominal pains, which she characterized as "terrible." She was unable to get out of bed; in fact, moving in bed was difficult and painful.

Examination. Patient was a female, somewhat undernourished, rather pale, but not acutely ill. Careful examination of the lungs (on the ground of a somewhat suspicious pulmonary history of twenty years ago) revealed nothing abnormal. Heart and blood vessels were normal. Blood pressure was 160/95. The abdomen was somewhat distended, abdominal muscles rather flaccid. Palpation disclosed a diffuse, doughy mass, slightly movable from side to side in McBurney's zone. It was tender to pressure, especially when pressed against the spine and posterior wall of the abdomen. While the mass was definitely palpable, its exact size could not be estimated, as it fused itself with other tissues. It was apparently not connected with the right kidney and suggested some pathology in the region of the coecum. Temperature was normal on entrance and remained so for the rest of the day. The urine was negative. Blood count revealed the following: Hemoglobin, 60 per cent; white count, 8900; red count, 4,500,000. The differential count was normal.

A definite diagnosis was not established, but it was quite clear that the patient had a surgical abdomen which demanded exploration. The repeated paroxysms of acute abdominal pains suggested an inflammatory process in the neighborhood of the coecum, possibly appendicitis. However, the absence of temperature, nausea and vomiting spoke against it. In the absence of any visceral symptoms, the diagnosis of tumor did not hold.

Operative Findings. A right pararectal incision was made. Upon opening the abdomen, the peritoneum was found considerably thickened and showed many adhesions. There was a segment of omentum adherent to the parietal peritoneum. Another segment was considerably infiltrated forming a mass, which was attached to the ascending colon, but did not compress it. The latter segment was edematous, grayish and contained a tablespoon of foul smelling pus. The inflamed omental mass was isolated and a resection well beyond the inflamed area was made. Careful search for a neighboring lesion failed to disclose any gross pathology. The appendix was free of adhesions, normal in appearance and was removed as a matter of routine. The abdomen was closed in the usual manner, without drainage.

We concluded that the patient had an acute epiploitis, to all appearances primary, since there was no evidence of any other pathology, either antedating or associated with the omental infection.

The postoperative course was uneventful until the fifth day when she complained of pain in the incision. At that time there was no redness or swelling present. On the sixth day, there was a rise in temperature and the pain became worse. In the following four days, the temperature rose to 101° to 102°F. and the pain was constant. On the tenth day, there appeared an elliptical mass in the incision which was tender and fluctuated. It was opened with the blunt end of a forceps allowing a cup full of foul smelling pus to escape. The discharge continued for four weeks when it ceased.

Pathological Report. Gross: The specimen measures about $7 \times 5.5 \times 1.5$ cm. and is roughly irregular in shape. It consists of fat with a central firm portion, one side of which shows an ulceration. The cut surface shows yellow and grayish areas. The appendix measures $5.5 \times .4$ cm. The serosa is pale, smooth, and glistening. The lumen is hardly visible.

Microscopic: Appendix: markedly increased number of eosinophilic leukocytes in the mucosa and submucosa. Omentum: a diffuse infiltration with leucocytes mainly eosinophilic, with plasma cells and lymphocytes. In places young granulation is present.

Pathologic Diagnosis: "Subacute appendicitis; subacute omentitis."

The diagnosis of inflammatory pseudotumors, as already suggested, is made upon the presence of a mass in the neighborhood of a previous operation, appearing from a few weeks to a couple of years later. The mass may or may not be sensitive to pressure, it is somewhat firm, doughy and may be associated with symptoms of peritoneal irritation, viz.: nausea, vomiting, chills and fever. If the mass is at or above the level of the umbilicus, it must be differentiated from pathology of the appendix or gall bladder, wandering liver, neoplasms of the spleen, tumor of the colon; below the umbilicus, from ovarian cysts, inflammatory masses and tumors in the pelvis. Occasionally, differentiation must be made from omental lipoma, cyst, malignancy, and tuberculosis. In the case of a firm fixed mass in the right illiac fossa, one should exclude the possibility of actinomycosis. Epiploitis, both acute and chronic, may mimic appendicitis. H. Schoemberg[17] reported 3 cases of acute hemorrhagic epiploitis, which simulated acute appendicitis. A painstaking inventory of symptoms, definitely establishing the sequence and order of events, will practically always make the diagnosis of appendicitis. In a number of cases, the presence of a mass associated with signs of ileus and a loss of weight suggested bowel malignancy. A rapid course with symptoms of ileus suggested intestinal obstruction. Teleky[27] reported a clinical complex resembling intestinal obstruction which proved to be an omental mass pressing upon the hepatic flexure of the colon, which disappeared upon the injection of fibrolysin.

By way of prophylaxis, one must avoid mass ligation of the omentum, especially if it is acutely inflamed or it is glued to the inflamed organ. The surgeon must reduce the handling of an inflamed omentum to a minimum. If resection is contemplated, one must pick up the individual blood vessels and ligate them separately. The omentum must be divided beyond the line of pathology well into the area of normal omentum.

The prognosis of these pseudo-tumors is rather favorable, since a number of cases

either disappear spontaneously or after rest in bed. The unfavorable cases may lead to peritonitis, perforate, or go on to general sepsis. In a case of Braun, death resulted from shock and hemorrhage.

The treatment should be conservative, somewhat along the line of the Ochsner treatment for appendiceal abscess. If resolution does not take place, incision and simple drainage should be done if an abscess is present. Morestin[28] extirpated a flap of omentum and marsupilized the abscess cavity by suturing it into the abdominal wound. In the presence of marked induration with a small amount of pus, extensive resection into normal omentum must be done. If the omentum is wrapped around some abdominal organ from which it cannot safely be detached, the mass should be extirpated in toto, reconstructing the anatomical loss, either at the time of the primary operation or at some subsequent time. In a case of Schmieden, for example, both omentum and gall bladder required removal en masse. Whenever the omental tumor is attached to a bowel causing stasis or obstruction, the removal of the omental mass may require either shortcircuiting or resection of the bowel.

On the whole, it can be said that the treatment of omental tumors ranged from the most conservative to the most daring. Many cases have improved on mere rest in bed, and ice bag to the abdomen; others have subsided spontaneously; some have improved greatly on iodides; finally, a great many cases required extensive surgery, either of the omental mass alone or of the mass and the surrounding organs. A small group of cases associated with loss of weight and cachexia, hard to the touch and apparently infiltrating surrounding structures, have definitely suggested malignancy and have, therefore, been dealt with in a radical fashion.

By way of conclusion, it occurred to us that a detailed discription of omental inflammatory masses may assist the clinican in the differential diagnosis of obscure and ill-defined abdominal tumors, thereby being a contribution to the diagnosis of abdominal tumors.

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PAPILLARY INTRACYSTIC ADENOCARCINOMA OF PROSTATE & MASSIVE BENIGN PROSTATIC CYST*

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THESE 2 cases are reported together because from the history, symptoms and physical examination they were very similar. Both were primarily cysts originating in and eventually replacing the prostate; then evidently hindered by the fascia of the bladder base on the one hand and the fascia of Denonvelliers on the other pushed upwards between the two fasciae and extended behind the bladder. One developed as a simple benign cyst containing 130 c.c. of straw-colored fluid. The prostate which remained after the erradication of the cyst became malignant, a rapidly growing adenocarcinoma. The other developed as a papillary intracystic adenocarcinoma of the prostate. Both were accurately diagnosed preoperatively by means of a specimen obtained through an aspirating needle inserted through the perineum.

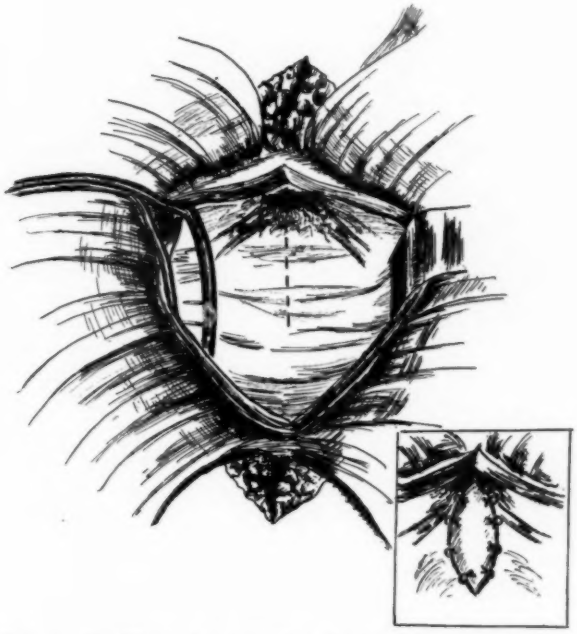

FIG. 1. Papillary intracystica denocarcinoma of prostate. Cyst is shown behind bladder.

FIG. 2. Operation in Case II. Cyst was made part of bladder cavity. Prostate subsequently became site of adenocarcinoma.

Both cases are very rare, the latter possibly unique. In both of these cases there is no question as to their prostatic origin. Both of the cysts were in the median line, neither had any relation to the seminal vesicles. In one of them (Case I) the symptom of hematuria undoubtedly was caused by blood from the tumor exuding through a patent prostatic duct emptying into the prostatic urethra. It is interesting to speculate upon the formation of these cysts. They must have had origin in the obliteration of a prostatic duct or a series of ducts and a slow development of a single large prostatic cyst. Just why one should develop a malignant growth and

* From the Urological Service, Memorial Hospital, New York City. Read before the Section on Genito-Urinary Surgery, N. Y. Academy of Medicine, May 18, 1932.

the other a totally benign growth is impossible to determine.*

Case 1. Papillary intracystic adenocarcinoma of the prostate. Memorial Hospital 41533.

A. L., aged fifty-nine, admitted to the hospital May 13, 1930, with the following history: His occupation was that of a stationary engineer. He has had the usual disease of childhood. Typhoid fever at nineteen years of age. He has been treated by a chiropractor for double inguinal hernia. His present illness began two years ago with hematuria. This has continued with periods of remission. It has been more intense during the last two months. There has been neither dysuria or pollakiuria. He has lost no weight.

The physical examination revealed that the patient's urine was microscopically bloody; that he had 60 c.c. of residual urine. The rectal examination revealed a prostate the size of a large orange, cystic in feeling, with a lump, quite hard at the top of the mass and a hard ridge on the right side. Cystoscopy showed a trabeculated bladder with some small papillomatous masses in the internal urethra.

His eyes, nose, mouth, throat, heart, lungs and abdomen were negative with the exception of a double inguinal hernia, the right reducible, no adenopathy. Blood pressure 120/78. A film of his lumbar spine and pelvis revealed some increase in density in the pelvis, but they were not characteristic of metastasis from prostatic carcinoma. His blood urea was not estimated prior to operation.

An aspirating needle was passed through the perineum into the cystic mass, guided by a finger inserted into the rectum. About 40 c.c. of pure blood was aspirated and then some plugs of soft, cellular tissue. After the withdrawal of the blood, many small nodules could be felt in the cyst wall. The pathological diagnosis of the aspirated material showed "adenocarcinoma."

Under spinal anesthesia the bladder was opened and the bladder found to be entirely normal. The median lobe of the prostate was large, merging into the lateral lobes. These three lobes were removed and a large cystic cavity $8 \times 6 \times 4$ cm. was opened up. This extended up behind the bladder and was filled with a papillary growth. There was a distinct cyst wall limiting the growth. Much of the papillomatous material was removed. Three tubes of radium screened by ½ mm. of silver were placed in the cyst. These totaled 164.7 millicuries and were left in the cyst for nine hours, giving a total radium dose of 1482 mc. hours. The bladder was closed and a suprapubic drainage tube left in place. We believed it would have been futile to mobilize the bladder and try to remove the cyst as metastatic growths were felt beyond the cyst.

The patient had profuse emesis postoperatively. This continued with some intervals of remission. Saline and glucose solutions in large quantities were given subcutaneously and intravenously. Persistent hiccoughing followed the vomiting. The patient died on the tenth day after operation, uremic.

The pathological report was as follows: "Adenocarcinoma and diffuse carcinoma. Bulky intracystic adenocarcinoma. The materials selected for examination were some of the papillary contents of the cyst and a portion of the indurated mass in the bladder base."

This very rare tumor of the prostate has not as far as I can ascertain been described.

The prostate in its duct system and anatomy is analogous to the female breast. A similar condition "papillary intracystic adenocarcinoma of the breast" is a relatively common disease. The loose connective tissue of the breast and the extensive duct systems allow, somewhat unhindered, the development of breast cysts in which papillary adenocarcinoma may develop. The prostate ducts are comparatively short. The prostate itself is somewhat restricted in growth by various surrounding fascias. The prostate sheath, the fascia at the bladder base and the fascia of Denonvelliers all inhibit extensive cyst formation. These two factors, the shortness of the prostatic ducts and the firm fascia around the prostate probably hinder the development of large prostatic cysts.

The cyst in the second case, described below, also pushed up behind the bladder between the fascia of the bladder base and the fascia of Denonvelliers.

*The remaining portions of the prostate of this patient became malignant. This has been controlled by interstitial irradiation.

Case II. Massive benign cyst of the prostate. Memorial Hospital 43543.

J. J. O'C., aged fifty-seven years, admitted to the hospital on August 11, 1931, with the following history: His symptoms began eight months ago (May, 1931) with dribbling at the end of urination. After that he had pain in his prostatic region and frequent and painful urination. His night urination was three to four times and his day urination every one and one-half hours. There had never been hematuria. He complained of a slight loss of weight and strength.

The physical examination revealed the following: He had at various examinations from 20 to 60 c.c. of residual urine. The urine was clear. A cystoscopy showed a normal bladder and prostate with the exception of a slight bulging of his median lobe. The rectal examination showed a mass at the site of his prostate, the top of which could not be reached. The mass was regular, smooth, tense and felt cystic. His blood urea nitrogen was 11.3 mg. Under spinal anesthesia 130 c.c. of bloody fluid was aspirated from the cyst. Following the perineal aspiration the cyst entirely disappeared as did his residual urine.

Examination of the aspirated fluid revealed no tumor cells.

Within a week the cyst had refilled. At a later date m viii of pure carbolic acid was injected into the cyst after aspiration of its contents; this did nothing. The cyst refilled and it was decided to operate upon the patient. Under spinal anesthesia the bladder was opened, the median lobe of the prostate broken into, the cyst opened and its contents evacuated. It was found to be a simple cyst with a smooth cyst wall. A portion of the wall was removed for pathological examination. The cyst was found to be adherent to the bladder wall and extended about 5 cm. behind the bladder wall. In the median line through the trigone an incision was made into the cyst cavity, so making it continuous, with the bladder cavity. The edges of this incision were sutured. A drainage tube was left in the bladder and the wound closed.

Before the operation mobilization of the bladder and dissection of the cyst was considered. Because of its attachment to the prostate and the depth of the cyst this was believed to be the poorer and more difficult procedure.

The patient's recovery was uneventful. Four weeks after the operation and the healing of the suprapubic wound, the patient had 20 c.c. of residual urine.

A pathological examination of the piece excised from the cyst wall revealed no tumor. About two months later because of the residual urine and stone formation the stone was crushed and washed out and the lower part of the bladder neck resected through the cystoscope. The removed material showed adenocarcinoma. This is to be treated with radium.

Wesson,[1] in a very extensive and excellent resume of the literature, reviews 29 cases of prostatic cysts, including 4 of his own. In but 3 of the cases reported were the prostatic cysts of large size and these were found at autopsy. In the large majority of cases retention of urine, partial or complete, was an important symptom. In most of the cases operated upon, the operation of choice was the opening or puncturing of the cyst by means of the cautery or by fulguration through the cystoscope. In 18 of the 29 cases the prostatic cysts were found at autopsy. In apparently none of them was as extensive an operation done as was performed in our case.

There is just one point that I should like to emphasize in considering these lesions, that is that they may be malignant and that the patient should be carefully watched for a considerable time to determine whether or not the cysts are part of a malignant degeneration. If the cyst fluid is bloody there is a greater chance that the condition may be malignant. I have seen one case in which a distinct cyst showed in the position of the median lobe of the prostate. This cyst was punctured by means of the cystoscope, bloody fluid escaping. I believed the condition benign. Further observation however proved that he had a myosarcoma of the prostate which was treated and cured by radium, the patient remaining well six years and dying of an intercurrent disease.

[1] Wesson: Cyst of the prostate and urethra. *J. of Urol.*, 13: No. 6, 1925.

BLADDER TUMOR

OBSERVATIONS ON ONE HUNDRED AND FIFTY CASES*

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A REVIEW of the literature since 1920 shows that within this period almost all the leading urological surgeons of this country and Europe have recorded their experiences with bladder tumor. Some have written upon a particular method of treatment, others have given us a comprehensive view of their results. In general, their conclusions are strikingly uniform; in this disease the operative mortality is high, recurrence of the growth is frequent, and the percentage of five year cures varies from 15 to 30 per cent.

Our reason for adding one more article to those already written on this subject is not that we have any new method of treatment to suggest, or that we find our results to be so good as to offer encouragement to others. All that we can do from this study of 150 cases is to show certain reasons why treatment is often unsuccessful, and to add our bit to the experience of other surgeons. It is only by an analysis of results that urologists can reach any reliable conclusions as to which methods of treatment are safest and which yield the most lasting results.

The series of cases upon which our study is based was taken from the records of the urological service of the Massachusetts General Hospital for the last ten years. As the number of cases did not quite total 150, a few cases selected at random from the practice of one of us were included. Great credit is due Mrs. Edith Stevens and Miss Linda Cannon of the Social Service Department of the Massachusetts General Hospital for their persistent efforts to obtain the end-results in this series of cases. Without these facts, we would be seriously handicapped in our effort to ascertain the value of the various methods of treatment which were employed.

TABLE I

GRADES OF MALIGNANCY IN AUTOPSY CASES

Grade	Pap. Ca.	Sq. Ca.	Ca. (Unclass.)	Adeno-carci-noma	Total
I.....	5	2	0	0	7
II.....	8	7	1	1	17
III.....	1	4	1	0	6
IV.....	0	1	0	0	1
Ungraded..	3	1	2	0	6
	17	15	4	1	37

TABLE II

METASTASES IN 34 AUTOPSIES

	Present 16					Absent 18					
Grade	I	II	III	IV	Not Graded	I	II	III	IV	Not Graded	Total
Papillary Ca..	3	2	0	0	1	2	4	1	0	2	15
Squamous Ca.	1	4	3	0	1	0	3	1	1	0	14
Ca. (unclass.)	0	0	0	0	1	0	1	1	0	1	4
Adenocarci-noma.....	0	0	0	0	0	0	1	0	0	0	1
	4	6	3	0	3	2	9	3	1	3	34

Let us first consider the characteristics of bladder cancer and the general physical condition of those who suffer from this disease as shown by the facts disclosed at autopsy. In this series there were 37 post-mortem examinations. Thirty-four of these were complete except for the head, one was limited to the abdomen, one to the genitourinary tract and one to the supra-pubic incision. In these autopsies, there

* From the Urological Department, Massachusetts General Hospital. Read before the Section on Genito-Urinary Surgery, New York Academy of Medicine, May 18, 1932.

were 17 papillary cancers, 15 squamous cell cancers, one adenocarcinoma, and 4 unclassified. The grading as to degree of malignancy is shown in Table I; it is to be noted that 13 of the papillary cancers were placed in Grades I and II, and one in Grade III, whereas 9 of the squamous cell cancers were in Grades I and II, 4 in Grade III and one in Grade IV.

Table II concerns the presence or absence of metastases in relation to the grade and type of tumor. The interesting feature about this table is that practically the same percentage (approximately 60 per cent) in both groups was in Grades I and II. Sixty-one per cent of the tumors which showed metastases were graded as being of relatively low malignancy, whereas 62 per cent of the tumors without metastases were similarly graded. Table III gives the percentage of cases without metastases according to type of tumor and according to grade; only 33 per cent of the Grade I cancers were free from metastases, whereas 60 per cent of Grade II and 50 per cent of Grade III were without metastases. In short, it appears from these figures that cancers determined by their microscopic characteristics to be in the more highly malignant grades are no more likely to metastasize than those in the less malignant grades. The squamous cell cancers however show metastases almost twice as frequently as the papillary cancers.

TABLE III
PERCENTAGE WITHOUT METASTASES

		Per Cent
Papillary Ca		60
Squamous Ca		36
Ca. (unclass.)		75
Adenocarcinoma		100
Grade I	all types (6)	33
Grade II	all types (15)	60
Grade III	all types (6)	50
Grade IV	all types (3)	100
Not graded	all types (6)	50
		36

The greater tendency of the squamous cancers to metastasize widely is illustrated in Table IV.

Table V attempts to show the relation between the degree of malignancy and the extent of distribution of metastases, but no definite conclusions can be drawn.

TABLE IV
METASTASES

	15 Papillary Carcinomas	14 Squamous Carcinomas	4 Unclassified Carcinomas
Lung	1	4	1
Liver	1	4	0
Vertebra	1	2	0
Pelvis	1	2	0
Retroperitoneal glands	5	5	1
Adrenal	1	0	0
Prostate	1	2	(Abscess)
Spleen	..	2	
Peritoneum	..	1	
Intestine	..	2	
Pancreas	..	1	
Heart	..	..	1

TABLE V
METASTASES IN 37 AUTOPSIES

To adrenal and retroperitoneal glands	Papillary 1.
To prostate only	Squamous II, Squamous III.
To pubis only	Squamous 1.
To retroperitoneal glands only.	Papillary 1, Papillary 1 Squamous ungraded.
Widespread	Squamous II, II, III; Papillary II, II, ungraded; Carcinoma ungraded.

Aside from the question of metastases, the facts learned at the autopsy table explain quite adequately the high mortality in bladder cancer. Chute[2] has called attention to the importance of pyelonephritis as a cause of death in these patients, and our autopsy findings support his conclusions. In 36 cases in which the condition of the kidneys was shown at autopsy, both kidneys were normal in but nine. (Table VI.) Actual obstruction of the ureter by the tumor is not necessary to produce this condition; severe bladder infection, especially if it is accompanied by some obstruction at the bladder outlet, will bring about infection and dilatation of the upper urinary tract. In our experience, the infected slough caused by radium, particularly if it is situated on the trigone or near the ureteral orifices, seems to be a very definite factor in causing pyelo-

nephritis on the side where the slough is found.

Table VI

RENAL CONDITIONS IN 36 AUTOPSIES

	Right Alone	Left Alone	Both
Dilated and infected	4	3	20
Essentially normal	2*	4	9

* Right kidney absent in one case.

Table VII

DISEASE (NOT METASTATIC) IN OTHER ORGANS

Pulmonary:	
Bronchopneumonia	9
Lobar pneumonia	1
Abscess	2
Emboli	2
Infarcts	1
Cardiovascular:	
H. and D. of heart	10
Acute endocarditis	3
Fibrous myocarditis	1
Coronary disease	4
Pericarditis	2
Arteriosclerosis	13
Luetic aortitis	1
Thrombosis iliac vein	1
Septicemia	2
Gastrointestinal:	
Gastric ulcers	1
Ulcers of ileum and colon	1
Perforation of cecum	1
Strangulated hernia	1
General peritonitis	3
Splenic:	
Infarcts and perisplenitis	1
Cerebral:	
Hemorrhage	1
Renal:	
Adenoma of kidney	1
Solitary kidney	1
Hepatic:	
Cholelithiasis	4
Acute hepatitis	1

In the great majority of cases cancer develops in the individual who has already entered that period of life in which occur the chronic degenerative diseases. The existence of such a condition may seriously affect a patient's ability to withstand a severe operation, such as cystectomy or resection, or to survive the profound toxemia which may result from a combination of necrosis and infection. The pathological conditions found at autopsy, aside from the cancer and its metastases, are listed in Table VII. They show a wide variety of lesions; some of these obviously developed after operation, but there are many which existed previous to operation, and may well have contributed to the fatal result.

The series of 150 cases which will be analyzed in this paper consisted of 136 males and 14 females. Their ages are shown in Table VIII. The average age in each class of cancer was close to sixty years, although in the squamous cell group it was slightly lower (fifty-six years). The youngest patient was thirty-five, the oldest about eighty; grouped by decades, over one-third of all cases occurred in individuals between sixty and seventy years of age.

Table VIII

GENERAL STATISTICS

150 Cases—Male	136
Female	14
	150

Average Age			Age by Decades	
	Cases	Years		
Papillary carcinoma	37	60	Youngest 35	Oldest 80
Squamous carcinoma	28	56	Under 40	2
Unclassified carcinoma	28	60	40–49	19
Adenocarcinoma	1	76	50–59	38
Papilloma	11	59	60–69	52
No biopsy	45	59	70–79	32
			80	2
			Unspecified	5
				150

The chief symptom in 125 cases was hematuria. Dysuria was mentioned as a symptom in 26; in 7 of these there was also hematuria, while in 18 there was dysuria without hematuria. Pain was a symptom in 6; it occurred in various regions of the abdomen, and in one case pain in the right lower leg was the only symptom. In this case *x*-ray showed metastatic growth in the upper end of the right femur and in the right ilium.

A glance at the table showing the duration of symptoms (Table IX) shows us at

least one reason why the present treatment of cancer of the bladder is so often a disappointment. In only 12 cases was the duration of symptoms one month or less. In but 40 per cent had the symptoms existed for six months or less. In 24 per cent the symptoms had been noticed for a period of six to twelve months, in 18 per cent for one to two years. Five patients had had symptoms for two to three years, 7 for three to four years, 4 for four to five years, 3 for five to six years, and 3 for more than six years. In the instances of very long duration of symptoms, one case of squamous cell cancer had a history dating back five years, another six years; cases of papillary carcinoma told of symptoms dating back four, four and one-half, five, six, seven and fifteen years. One case of papilloma had had hematuria for six years, and one for twenty-four years. It is easy to understand how a long duration of symptoms might be found in cases of simple papilloma, but a history of bleeding covering a period of six, seven or fifteen years in cases of proven cancer would seem to us strong evidence that the tumor began as a benign growth and later degenerated into a malignant one. One of our cases which was operated upon for a tumor which was reported to be a papilloma later developed an infiltrating growth of the bladder wall; other writers have observed a similar metamorphosis. (Barringer.[1])

Tables x and xi show the characteristics of the tumors in this series, both as regards their gross appearance and their microscopic grading. Unfortunately only one-third of the series had been graded, but even so the number so rated was sufficient to give some idea of the distribution of the various grades.

As regards their treatment, these 150 cases are divided into seven classes. Those were regarded as inoperable in which no operation was done, or in which a simple cystostomy without treatment of the growth itself was all that the surgeon attempted to do. A second group comprised those cases in which the growth was excised without resection of the entire

Table ix

SYMPTOMATOLOGY

Presenting Symptoms

	Cases
Hematuria	125
Dysuria	26
Pain (not vesical)	6
Unspecified	6

Duration of Chief Symptoms

Less than 1 month	12	2–3 years	5
1–2 months	11	3–4 years	7
2–3 months	15	4–5 years	4
3–4 months	7	5–6 years	3
4–5 months	5	6–7 years	1
5–6 months	10	15 years	1
6–12 months	34	24 years	1
12–18 months	9	Unspecified	8
18–24 months	17		150

Sixty or 40 per cent came to hospital within six months of first symptoms.

Table x

TYPE OF TUMOR BY GROSS CHARACTERISTICS

	Under 4 Cm.	Over 4 Cm.	Single	Multiple	Infiltrating	Papillary	Unclassified
Pap. ca	..	..	21	16	10	27	0
Sq. ca	10	18	19	9	26	2	0
Ca. (unclass.)	..	..	22	6	16	12	0
Adeno-ca	..	..	1	0	1	0	0
Papilloma	..	..	7	4	1	10	0
No biopsy	..	..	25	14	26	13	6
			95	49	80	64	6

bladder wall. The third group consisted of resections, the fourth of total cystectomies, the fifth of tumors destroyed by electrocoagulation, the sixth of those destroyed by simple cauterization and the seventh of those in which radium was used. The operations were performed by some half dozen surgeons on the Urological Service.

Table XI

TYPE OF TUMOR BY GRADE

	Grade I	II	III	IV	Unspecified	Total
Papillary carcinoma	15	7	1	0	14	37
Squamous carcinoma	3	8	5	2	10	28
Unclassified carcinoma	0	2	4	2	20	28
Adenocarcinoma	0	1	0	0	0	1
Papilloma	0	0	0	0	11	11
No biopsy	0	0	0	0	45	45
	18	18	10	4	100	150

ten months, one only after two years and seven months. In 4 of these cases, diversion of the urinary stream was done, 3 by ureteroenterostomy, one by ureterostomy. Two died within two months, one after four months, one after nine months, of cancer. Operation may have decreased the suffering in these operated cases, but it certainly did not prolong their lives.

Table XIII summarizes the results of excision or cauterization, and of total cystectomy. The patient with papilloma that died of cancer of the bladder six years after operation had an excision of a single non-infiltrating tumor. Six years later this patient was found to have a flat infiltrating mass about the bladder neck, and numerous papillary tumors. One lived fourteen years and died of cerebral hemorrhage. He continued to have occasional attacks of hematuria until his death. Three patients

Table XII

TREATMENT

	Papilloma	Papillary Carcinoma	Squamous Carcinoma	Unclassified Carcinoma	Adenocarcinoma	No Biopsy	Total
Primary tumor inoperable	0	4	4	3	0	22	33
Excision	5	2	0	0	0	0	7
Resection	0	3	6	6	1	3	19
Cystectomy	0	1	2	2	0	0	5
Electrocoagulation	1	11	7	5	0	10 (3 through cystoscope)	34
Cauterization	0	0	3	0	0	0	3
Radium	5	15	8	13	0	8	49
	11	36	30	29	1	43	150

Taking these groups seriatim, we find that of the first group, 33 cases, there were 21 that were considered inoperable upon cystoscopic evidence. Of these patients, 16 died within three months, one within four months; another patient died after an operation for a strangulated hernia, and one that refused operation died three years later of cancer. Nine had cystotomies; of these 5 died within three months, one at four months, one at five months, one at

were apparently cured, one being free from recurrences when cystoscoped five years after operation, and 2 being alive after ten and eleven years respectively.

Five total cystectomies were done, the ureters being implanted in the bowel in 4 and brought out to the skin in one. Two were operative deaths; the other 3 patients lived ten months, fourteen months and thirty-one months. One died of metastasis to the spine and resulting paralysis, another

of carcinoma (location not stated) and the third of myocarditis and nephritis, with a question of metastasis in the lung.

in 34 cases, 26 per cent. (Table xv.) Seven patients died of cancer after intervals varying from two months to two years and two

Table xiii

Results of Treatment

Excision or Cauterization, 10 cases

	Operative Death	Alive with Recurrence	Cancer Death	Death Other Causes	Apparently Cured
Papilloma	0	2	6 years	14 years, cerebral hemorrhage	3
Papillary carcinoma	1	1?	.....	1½ years, suicide	
Total Cystectomy, 5 cases					
Papillary carcinoma	0	0	1 year 2 months	0	0
Squamous carcinoma	1	0	2 years 7 months	0	0
Carcinoma, unclassified	1	0	10 months	0	0

Table xiv

Results of Treatment

Resection, 19 cases

	Operative Deaths	Recurrence	Death from Carcinoma	Death from Other Causes	Apparently Well
Papillary carcinoma	1	1–3 years	1 year	0	0
Squamous carcinoma	1	.....	4 years (3 resections)	6 months (broncho-pneumonia)	4 years
				8½ months (broncho-pneumonia)	6 years (2 resections)
Carcinoma (unclassified)	1	.....	3½ months	2 years 7 months (suicide)	
			6 years	3 years 7 months (cause?)	
			3 months		
No biopsy	2	.....	.....	.....	7 years
Adenocarcinoma	1				

In Table xiv are shown the results of resection in 19 cases. There were 6 operative deaths and 3 apparent cures. One of these was free from growth on cystoscopy at the end of four years, another at the end of seven years. A patient dying by his own hand two and one-half years after operation may or may not have been cured. One infers that he was not. There were 5 deaths from cancer, at three months, at three and one-half months, one year, four years and six years. There was another case with recurrence after three years.

Electrocoagulation as a method of treatment was followed by 9 operative deaths

months. Four died of other causes, all but one within a few months. Nine are alive and so far as we know well after three months, six months, three years, three and one-half years, four years, five years, seven years, nine years and eleven years. Five are alive but with recurrences.

The cases in which radium was used number 41 (Table xvi). In practically all of these cases the technique which was followed consisted in removing the projecting portion of the tumor with the diathermy knife and implanting in and about the base of the tumor gold seeds of radon varying in strength from 1 to 2 millicuries

each. These seeds have a wall 0.2 mm. thick; they are implanted about 1 cm. apart. In a few cases needles containing larger amounts of radium (12.5 mg.) were also employed. The total dosage varied with the size of the tumor, but in general we endeavored to follow the technique of Barringer.[1] In the tabulation, operative deaths include all deaths in the hospital. There were 17 of these, a percentage of 41. Deaths from cancer totalled 15; from other causes, 5. Of these, several cases may have

TABLE XV
RESULTS OF TREATMENT
Electrocoagulation, 34 cases

	Operative Deaths	Recurrence	Cancer Deaths	Death from Other Causes	Apparently Cured
Papilloma	0	?		Uremia—10 mos.	0
Papillary carcinoma	4	1	2 mos.	Carcinoma uterus (3 years)	3 years 3½ years 3 months 7 years 9 months
Squamous carcinoma	3	1	14 months	Uremia Nephrostomy (Operative death) 3 months (cause?)	0
Carcinoma (unclassified)	1	1	3 months 5 months 5 months 2 years 2 months	0	0
No biopsy	1	3–4 years 2 years	2 years 2 months	5 months (cardiac)	6 months 11 years 9 years 5 years 4 years

TABLE XVI
RESULTS OF TREATMENT
Radium

	Op. Deaths	Recur.	Ca. Deaths	Death from Other Causes	App. Well
Papilloma	2	..	6 yrs.		6 mos. 1 yr. 9 mos.
Pap. ca	8	2	11 mos.	4 yrs. 3 mos. (cause?) 5 yrs. 1 mo. (cause?)	3 mos. 7 yrs. (2 ops.) 1 yr. 1 yr.
Sq. ca	3	1	1 yr. 6 mos. 1 yr. 3 mos.		9 yrs.
Ca. (unclass.)	3	2	1 yr. 3 mos. 1 yr. 8 mos. 3 yrs. 1 yr. 6 mos. 6 mos. 1 yr. 5 mos.		7 yrs. 9 mos.
No biopsy	1	..	8½ mos. 2½ mos. 2½ mos. 3 mos.	7 yrs. (arteriosclerosis) 3 yrs. 3 mos. (cause?) (No ca. 2½ yrs. postop.) 2½ yrs. (cause?)	

been cancer free. There were 5 living patients with recurrences, and 8 without. Only 4 of these 8 had gone more than one year, however.

Table xvii
operative deaths (35)

Most frequent causes:	
Shock	4
Infarcts	2
Sepsis	4
Hemorrhage	2
Pyelonephritis and uremia	10
Pneumonia	5
Pulmonary embolism	1
Cardiac failure	10
Peritonitis	4

employed. The honors are about evenly divided between the three methods of excision, electrocoagulation and radium implantation. Resection is conspicuously absent, but there were several patients just within the five-year period who were well following a resection.

Out of this welter of statistics what conclusions are we entitled to draw? It seems clear that the grading of bladder tumors by the microscope has but little influence upon the prognosis. We have seen that tumors graded I and II are as likely to metastasize as those graded III and IV. In

Ureteroenterostomy..... 10 times — 2 operative deaths
Ureterostomy..... 2 times — 1 " " (total cystectomy)

Table xviii
results of treatment, all types

	No. Cases	Operative Deaths	Recurrence	Cancer Deaths	Other Causes	Possibly Cured
Excision and cauterization	10	1—10%	3	1	0	4—40%
Resection	19	6—32%	1	5	2	5—26%
Cystectomy	5	2—40%	0	3	0	0— 0%
Electrocoagulation	34	9—26%	5	7	6	10—29%
Radium	41	17—41%	5	15	5	13—32%
		35—30%	14	31—26%	13	32—27%

Total operations—117

In the entire group of 117 operations, excluding simple cystotomies, there were 35 operative deaths, a percentage of 30. The most frequent causes of death are listed in Table xvii. Renal insufficiency and cardiac failure occupy the prominent places, with 10 deaths attributed to each. Pulmonary complications are a close rival, there having been 5 cases of pneumonia, 2 infarcts and one embolus.

Table xviii summarizes the results of surgery in this group of bladder tumors. In the column headed "possibly cured" we have placed not only those known to be free from recurrence after five years, but also those patients dying of other causes after an interval of at least three years. Table xix lists the actual five-year cures, with a brief resumé of the type of tumor involved and the method of treatment

cases coming to autopsy, metastases are present in almost half the cases. We do not know, unfortunately, what proportion of late postoperative deaths from cancer are due to local recurrences, and what proportion to distant metastases. Our limited experience with total cystectomies has shown us that even if the local growth has been removed, the development of distant foci is by no means unusual, and cannot be foreseen.

As we have already pointed out, there is far too much delay between the onset of symptoms and the establishment of a diagnosis. Forty per cent enter the hospital less than six months after the appearance of the first symptom, and 65 per cent enter within a year; we need look no farther to find the reason why 22 per cent of all our cases were inoperable. In looking over

the results of treatment, it would appear that some of the other cases, in which valiant attempts were made to destroy the growth, would have been better off without such an attempt having been made.

and of mineral oil (as suggested by Greenberg) at the time of cystoscopy is often very helpful. Careful bimanual palpation of the bladder will give valuable information as to the extent of induration. We

TABLE XIX
FIVE YEAR CURES

	S.	M.	Grade	Inf.	Pap.	Method	Time
Papilloma	Yes	....	None	....	Yes	Excision	11 yrs. 6 mos.
	Yes	....	None	....	Yes	Excision	5 yrs. (cystoscopy)
	Yes	....	None	....	Yes	Excision	10 yrs. 3 mos.
Pap. ca	Yes	....	I	....	Yes	Electrocoag.	7 yrs. 9 mos.
		Yes	None	....	Yes	Radium—2 operations	7 yrs. (after 2nd operation)
Sq. ca	Yes	....	None	Yes	....	Radium	9 yrs.
Ca. (unclass.)	Yes	....	None	....	Yes	Radium	7 yrs. 9 mos.
No biopsy	Yes	....	None	....	Yes	Electrocoag.	11 yrs. 3 mos.
		Yes	None	....	Yes	Electrocoag.	9 yrs.
	Yes	....	None	Yes	....	Electrocoag.	5 yrs. (cystoscopy)
	Yes	....	None	Yes	....	Radium	7 yrs. 2 mos.
							11 cases

Responsibility for this delay does not belong entirely to the patients themselves. We are all too familiar with the story that the patient on first noticing blood in the urine consulted his physician and was told that "this medicine would fix it up," or that "it was nothing to worry about." The medical profession in general must be made aware of the significance of hematuria, and must learn to have earlier investigation of all patients whose urines show unexplained blood or whose vesical behavior shows a departure from normal.

When the patient does come for urological study, that study should include a careful investigation of the cardiovascular system as well as the urinary tract. The skeleton and chest should be *x*-rayed for metastases. The renal function should be determined by blood chemistry studies; the question of ureteral obstruction should be settled by intravenous pyelography, provided the renal function as a whole is not seriously impaired.

The cystoscopic examination should be repeated until a satisfactory view is obtained. Bleeding may have to be checked by catheter drainage; the use of adrenalin

have not thought it desirable or particularly useful to remove bits of tumor through the cystoscope for diagnosis. The facts brought out in this study of 150 cases bear out our belief that the microscopic characteristics of the tumor are of little value in determining the form of treatment to be used.

From the investigations just outlined we gather the facts upon which we base our plan of treatment. If the case appears to be operable, we must decide upon the type of operation to employ. We believe that in the future we should be more conservative in our selection of cases for operation, and more radical in the operation itself. Resection we believe is the operation of choice in patients who are good operative risks and whose tumors are favorably situated for resection. Total cystectomy is most likely to produce a cure in those cases in which other less drastic measures may be employed with a reasonable hope of success. As we employ it now, in the cases which are unsuitable for other forms of treatment, the dice are loaded against us. Renal damage and metatastic deposits have probably already taken place. That

there is a very limited number of cases which can best be handled by cystectomy we do not doubt, and we shall continue to consider this operation as a possibility.

As for the other measures frequently employed,—electrocoagulation and radium implantation,—we believe that the widespread, superficial tumors are more suitably treated by the former method, whereas the single, infiltrating tumors not over 4 to 5 cm. in diameter should be treated by radium implantation.

In our series, 34 cases treated by electrocoagulation showed an operative mortality of 26 per cent as compared with an operative mortality of 41 per cent in 41 cases treated with radium. The "possible cures" were about 30 per cent in each class. The price which the patient has to pay in suffering is much greater when radium is employed. We have observed a number of cases of radium ulceration which have persisted for months and in some cases for several years. The bladder may become so contracted that 2 ounces' distention causes most intense pain. Such cases may be cured of cancer, but a substitute scarcely more welcome has taken its place.

In spite of these objections to the use of radium, we believe that it occupies a unique place in the treatment of bladder cancer; that in certain cases in which resection is practically impossible or at least too loaded with risk, and in which electrocoagulation is not sufficiently penetrating or perhaps too penetrating, radium will provide us with a means of destroying the growth. We protest against the indiscriminate use of radium, or its employment in hopeless cases simply as a sop to our conscience.

The urological surgeon, in his management of a case of cancer of the bladder, must be directed by what he knows of the patient's condition and by what he knows he can do by the various methods which he has at his command. Often his preconceived plan of action is entirely upset by the conditions which confront him when the bladder is opened. In all urological surgery, and perhaps in general surgery as well, there is no more difficult, more complex, situation.

SUMMARY

1. One hundred and fifty cases of tumor of the bladder have been studied as to age, symptomatology, type of tumor, treatment and end result.

2. Thirty-seven autopsies have been analyzed as to type and grade of cancer, presence and distribution of metastases, and existence of other pathological conditions.

CONCLUSIONS

1. The grade of malignancy of bladder cancer has no demonstrable relation to its tendency to metastasize.

2. Squamous cell cancers metastasize almost twice as frequently as papillary cancers.

3. One important cause of the poor results in the surgery of bladder cancer is the long period of delay between the occurrence of the first symptom and the patient's entrance into the hospital.

4. A comparison of the results of resection, electrocoagulation and radium implantation shows the lowest number of hospital deaths in cases treated by electrocoagulation, 26 per cent. The next lowest is in cases treated by resection, 32 per cent; the highest is in cases treated by radium implantation, 41 per cent. The end results from these three methods are approximately the same.

5. No one method is suitable for all types of cancer. The surgeon should be prepared to employ whichever method seems best suited to the individual case.

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CONGENITAL VESICAL NECK OBSTRUCTION

IN A FEMALE CHILD DUE TO CUP-VALVE FORMATION: OPEN OPERATION: COMPLETE RECOVERY*

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BROOKLYN, N. Y.

PATIENT E. B., aged five years, female, was admitted to the Long Island College Hospital on March 24, 1930, complaining of pains in the back and abdomen, headache, intermittent fever and pus in the urine.

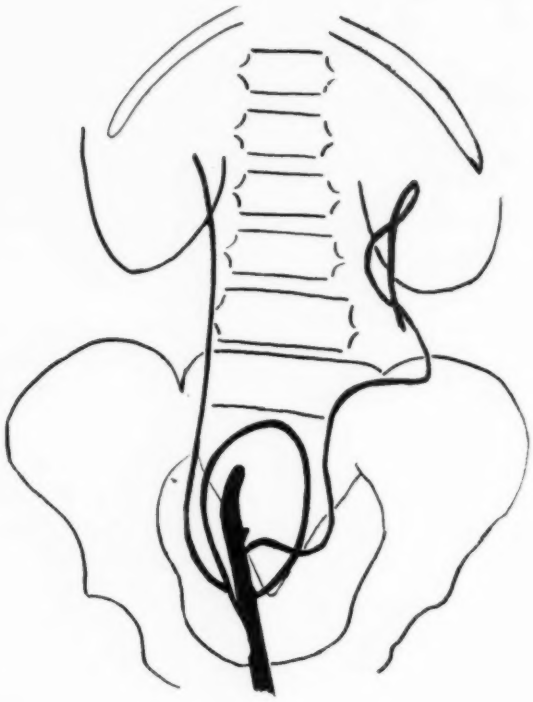

FIG. 1. Radiograph with opaque catheters in situ (March, 1930).

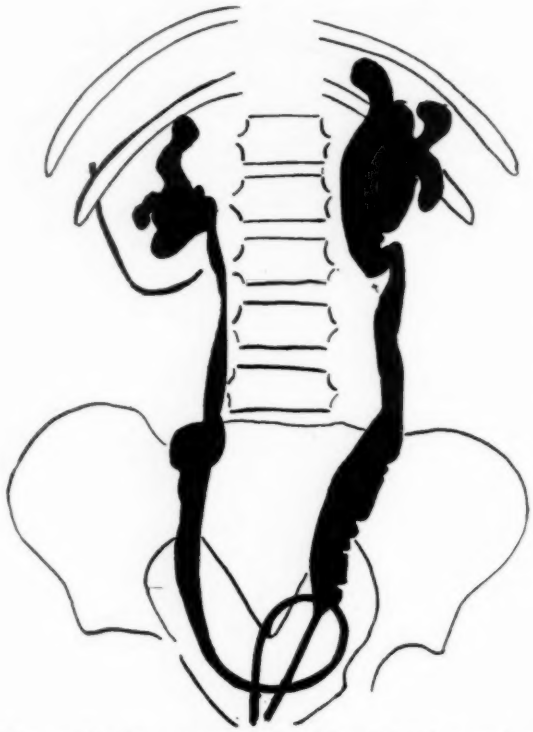

FIG. 2. Double ureteropyelograms (March, 1930) showing double hydro-uretero-nephrosis.

Family History: Mother had active tuberculosis, requiring two therapeutic abortions in early married life. A grandmother had tuberculosis and an aunt died of tuberculosis.

Previous History: Child was weaned at the age of three and one half months on account of mother's poor health. Patient had never really been well since birth, in spite of special attention to diet and careful hygienic supervision. Three years ago she was ill for three months with abscessed cervical glands following whooping cough.

She was weak, fussy and irritable, with moderate fever, more or less, every day, accompanied with some abdominal pain. These attacks would recur every few months, and, no doubt, were due to urinary obstruction. Of late, the attacks of backache and abdominal pain, especially on the right side, had been getting more frequent and more severe. Pains would occur for a few hours each day for a few days and then would subside after a few days. For three weeks the pain had been more severe, starting in the back and radiating to the flank and abdomen. The mother stated that the child would throw herself on the floor during severe attacks. In view of previous history and known pyuria, it is evident that, at that time, a uroseptic condition existed and was overlooked

* From the Department of Urology, Long Island College Hospital.

FIG. 3. Cystogram (March, 1930) showing dilated bladder and reflux into both ureters and pelves. (Right ureter incompletely outlined.)

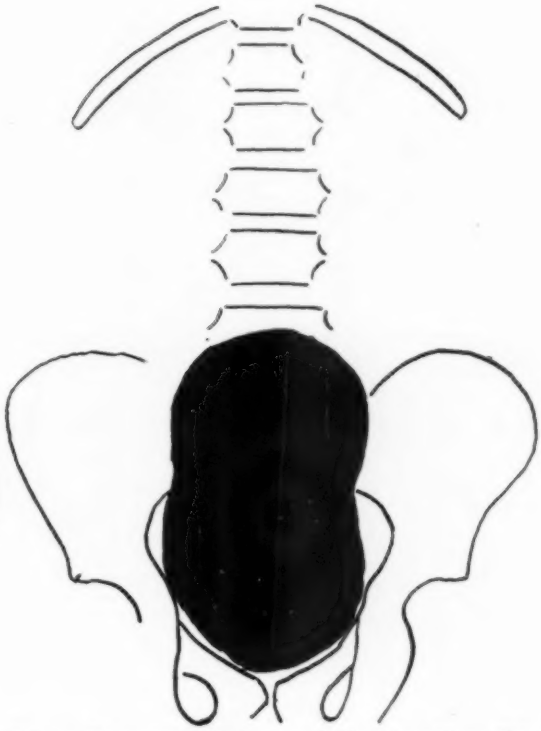

FIG. 4. Cystogram (July, 1930) showing dilated bladder but no manifest ureteral reflux.

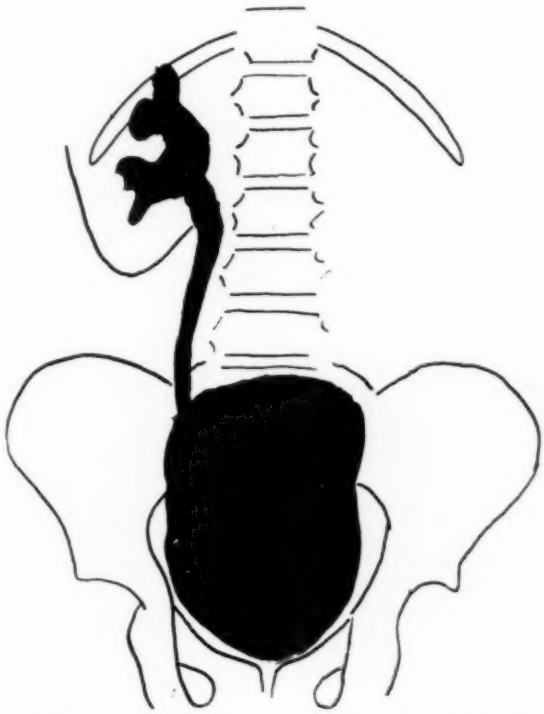

FIG. 5. Uroselectan (July, 1930) fifteen minutes, shows good elimination of right kidney, with no visual elimination from left.

FIG. 6. Uroselectan (July, 1930) thirty minutes, no appearance from left kidney.

FIG. 7. Uroselectan (July, 1930) after one hour, delineating diffuse dilatation of entire upper urinary tract.

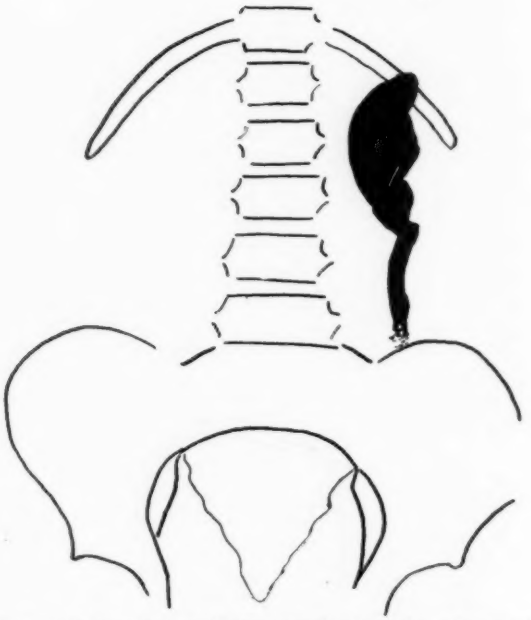

FIG. 8. Uroselectan (July, 1930) after three hours, indicating delayed emptying of left kidney.

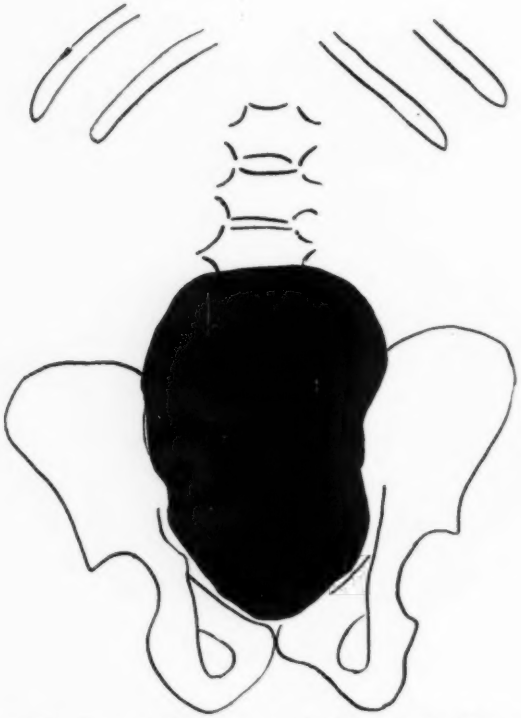

FIG. 9. Cystogram (August, 1931) shows little, if any, improvement in dilated atonic bladder, despite normal function of evacuation.

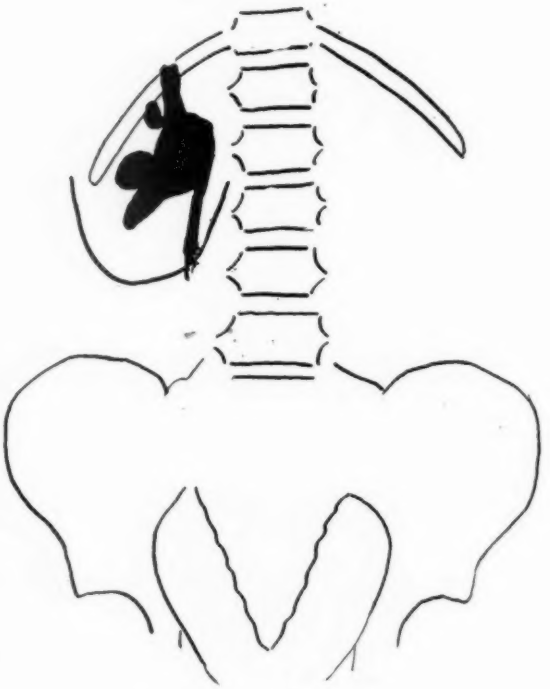

FIG. 10. Uroselectan (August, 1931) after twelve minutes, reveals good function of right kidney, dilated pelvis, no appearance of drug in left kidney.

because of the other clinical manifestations. There was no history of hematuria, dysuria, vomiting, or convulsions.

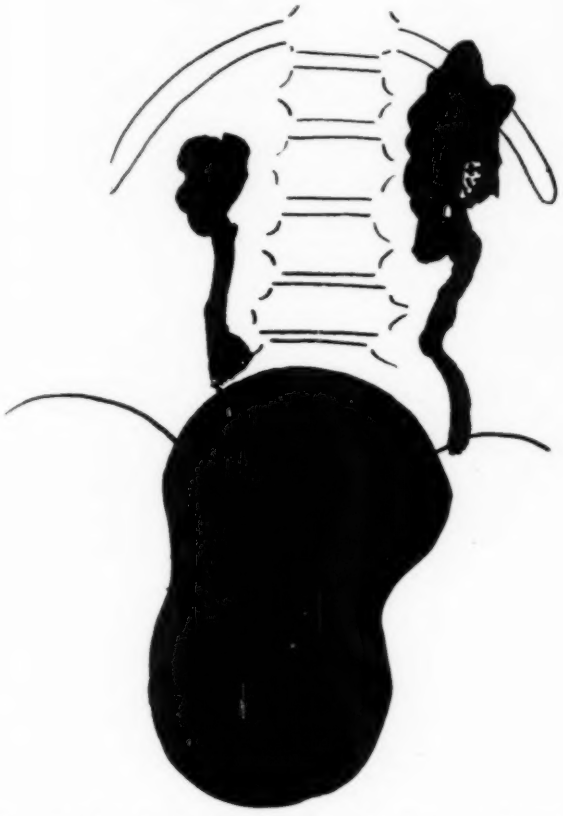

Fig. 11. Uroselectan (August, 1931) after two hours, reveals hydro-uretero-nephrosis and dilated bladder similar to that of a year ago preceding operation. (Complete recovery, however, from residual urine and pyuria.)

Physical examination showed some enlargement of the cervical glands. There were no lesions found in the heart or lungs. Abdominal examination was negative, except for some tenderness on deep pressure over the right kidney. Reflexes were normal. The provisional pediatric diagnosis on admission was congenital abnormality of the right kidney or right renal tuberculosis. The tuberculin test was strongly positive. Nothing was found in the sinuses, ears, nose or throat to explain the febrile condition. Urinalysis always showed a hundred or more pus cells to the field and blood examination showed leucocytosis and negative Wassermann reaction.

Cystocopy March 27, 1930, performed by a colleague, showed a dilated bladder with dilated ureters and renal pelves, with B. coli infection of bladder and both kidneys. The cystogram also showed ureteral reflux. Tubercle bacilli were never found in the urine. The blood chemistry revealed definite nitrogen retention.

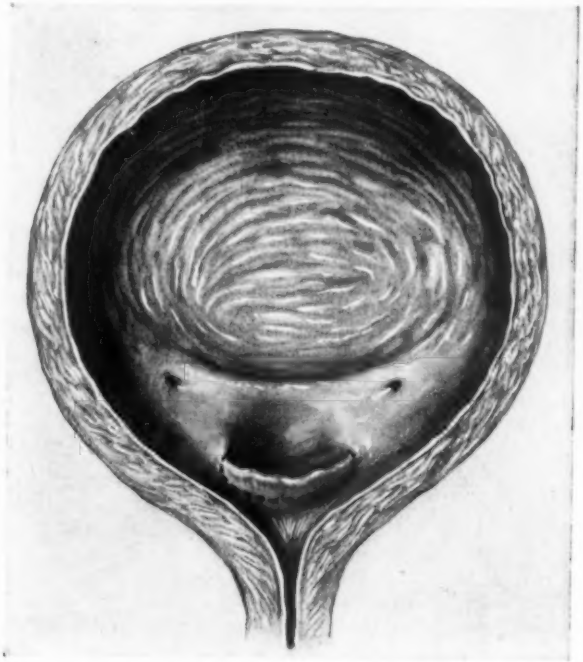

Fig. 12. Bladder showing cup-valve formation at vesical outlet. Dotted line indicates line of incision used in operative procedure.

Gastrointestinal series of radiographs were negative. At this time cystotomy was advised, but it was finally decided to try expectant treatment, including a regime of rest and strict hygiene, this treatment to include bladder irrigations and careful supervision.

Readmission. She was re-admitted to the hospital on July 7, 1930 for complete study, having improved considerably and having gained 9½ pounds in weight since the last admission. At this time uroselectan study, including cystogram, showed no change in the genitourinary findings. In spite of these data, conservative treatment was carried out and the child allowed to go home under the same regime.

Third Admission to Hospital. She first came under my observation on September 4, 1930, when she was admitted for the third time, with recurrence of pains in the back and side, and showing persistence of pyuria and with large amount of residual urine. However, she had gained 3 pounds in weight since leaving the hospital. In view of the recurrence of more severe symptoms, I advised open operation. The increased nitrogen retention and urosepsis

required relief from the vesical neck obstruction, which was evident. A second cytoscopic examination was not deemed advisable. The

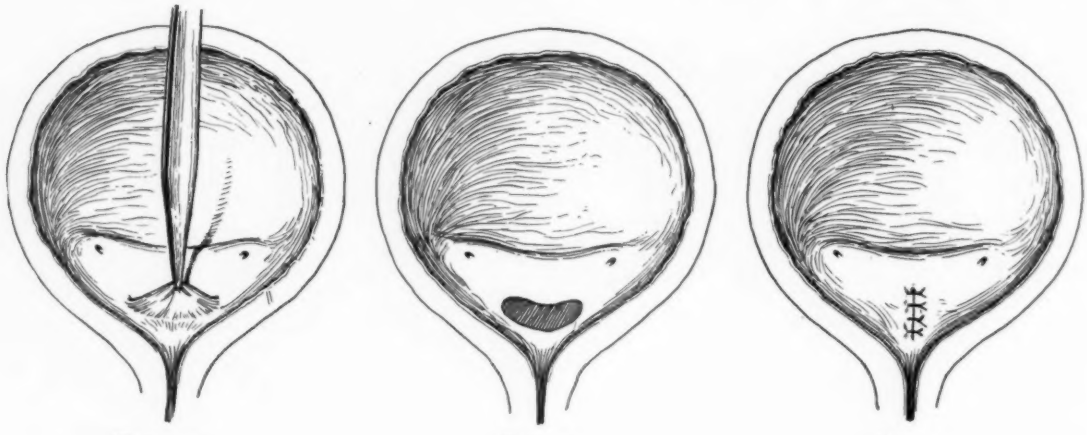

Fig. 13. Fig. 14. Fig. 15.

Fig. 13. Cup-fold of mucous membrane held upward with forceps.
Fig. 14. Raw surface exposed after resection of redundant membrane.
Fig. 15. Closure of raw surface by interrupted sutures passed in opposite direction.

first cytoscopic examination had failed to visualize the valve condition, probably because the cytoscope caused the membrane to flatten out against the vesical mucosa. The preoperative diagnosis was, therefore, stenosis or fibrosis of the vesical neck.

Operation. After preliminary bladder drainage and irrigation, cystotomy was performed on September 8, 1930. The bladder was markedly thickened but with very little trabeculation and no diverticulum. We then exposed a cup-like, elevated, rather large fold of redundant mucous membrane with the concavity upward, lying transversely just behind the internal urethra and acting as a perfect cup-valve, shutting off the vesical outlet. This was carefully and completely resected, including a portion of adjacent overstretched, redundant, and thickened mucous membrane on the floor of the bladder. There was a moderate-sized fossa formation just posterior to the valve. The raw surface remaining was closed with interrupted, fine catgut sutures carrying the suture line in the opposite direction, to give length to, and funnelize the outlet. Suprapubic tube drainage was provided in the usual manner.

Convalescence was satisfactory but somewhat slow. The phenolsulphonphthalein and blood chemistry tests showed a steady and continued improvement in function and the patient left the hospital October 16, 1930, with the wound healed, moderate pyuria and a residual urine of about 2 ounces.

Under the careful supervision of a pediatrician, at her home in the country, she gained very rapidly and has apparently fully recovered from her long-standing illness. There is no pyuria at present, no residual urine and the blood chemistry is normal. She attends school regularly. She contracted infantile paralysis during the 1931 epidemic, and recovered quickly from this disease without complications. Intravenous urography, done about a year after operation, failed to show much improvement in the evident dilation of the bladder, ureters and pelves. (All urograms showed delayed function of the left kidney, both before and after operation.) Despite the large size of the bladder, however, it is now emptying itself completely.

COMMENT

In conditions of dilated bladder in infants and children, with or without diverticula, nerve and cord lesions, urethral stricture and meatal obstruction having been ruled out, the urgent need for careful instrumental study of the vesical neck region and posterior urethra is apparent. I believe the true etiology will thereby be more frequently demonstrated, and removed before advanced disease changes have taken place; furthermore "idiopathic

dilatation" of the bladder will less often be the accepted diagnosis.

In congenital obstructive cases, the degree of obstruction is naturally the determining factor in the severity of symptoms, and in bringing the patient to a correct diagnosis at an earlier period of life.

With the popularization of cysto-urethroscopic study in children, more vesical neck lesions are being demonstrated. A number of valve formations in male children associated with the embryological defects of the verumontanum and hypertrophied frenula are recorded. The latter condition does not apply in the case herewith presented.

So far as I am aware, this is the first case of congenital valve obstruction at the vesical neck in a female child to be reported in the literature.

Campbell reports a recent case of trigonal curtain behind the vesical outlet in a female child of fifteen months. This case is in a measure somewhat similar, but not the same lesion. The effects produced by the lesion, however, are almost identical.

I wish to express my sincere thanks to Dr. D. E. Overton of the Pediatric Department for his assistance and interest, and for the shadow-tracings of radiographs.

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EFFECT OF LUMBAR GANGLIONECTOMY UPON REPAIR OF BONE

EXPERIMENTAL STUDY*

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THE development of surgery of the sympathetic nervous system was stimulated by the work of Leriche[1] when he reported his first periarterial sympathectomy in 1913, and it was given additional impetus by the work of Royle[2] who in 1924 advocated ramisection of the sympathetic chain for spastic paralysis of the extremities. Since that time ganglionectomy or periarterial sympathectomy has been advocated as a form of therapy for a variety of conditions. The reported clinical results vary and at times are confusing. The effects of ganglionectomy are said to be more pronounced and lasting than those following periarterial sympathectomy.[3]

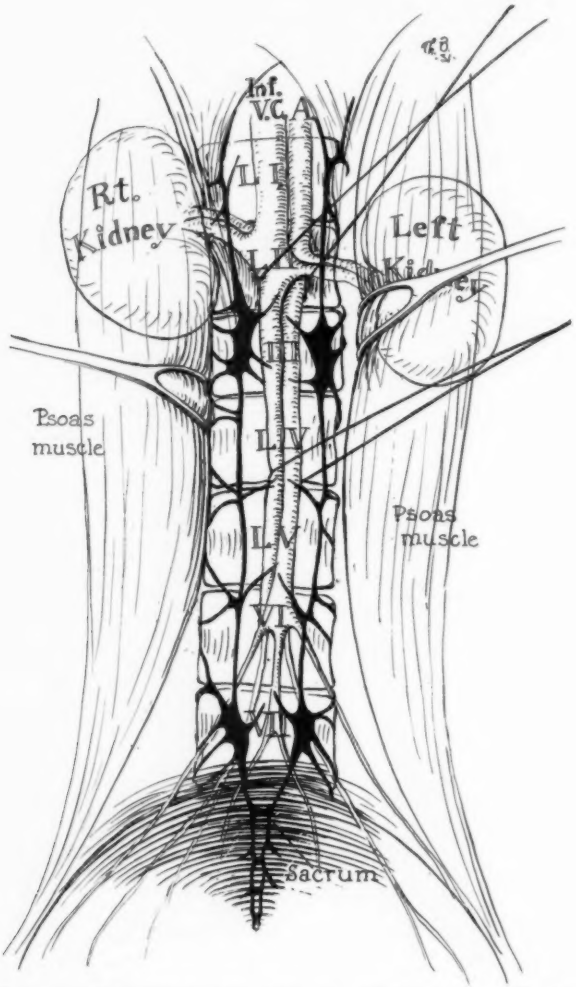

FIG. 1. Schematic drawing of lumbar sympathetic chains in a dog.

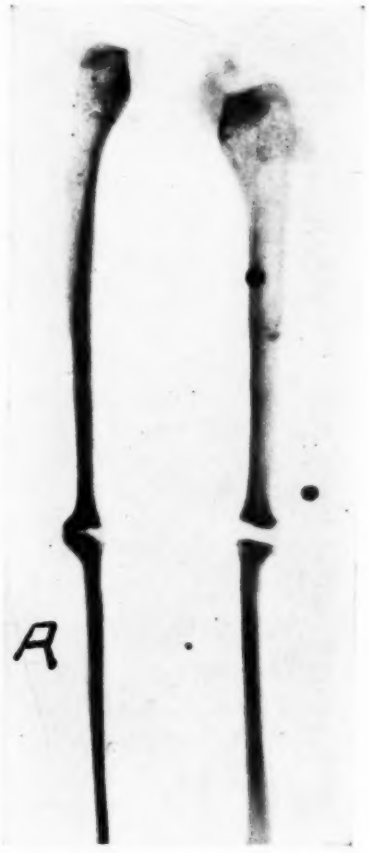

FIG. 2. Roentgenograms of the fractured fibulae removed at autopsy. Definitely more repair on the right side. A left lumbar ganglionectomy had been done. (Dog 4.)

A common condition for which periarterial sympathectomy has been advo-

* From Laboratory of Surgical Research, Western Reserve University School of Medicine & Lakeside Hospital.

cated is ununited fracture of an extremity. Stropeni[4] has reported 3 cases of ununited fractures of the lower legs in which healing occurred after periarterial sympathectomy of the femoral artery on the affected side. Rubaschow[5] reported 2 or 3 cases in which a periarterial sympathectomy was performed for ununited fractures of the lower extremity. He obtained partial success in one case. Fontaine[6] of Leriche's Clinic has reported good results following periarterial sympathectomy in cases of defective consolidation of fractures of the extremities. He also fractured the metatarsals of two dogs and the tibiae in one dog, and followed this with a periarterial sympathectomy of the femoral artery on one side. He found that the repair of bone occurred more rapidly on the side operated upon.

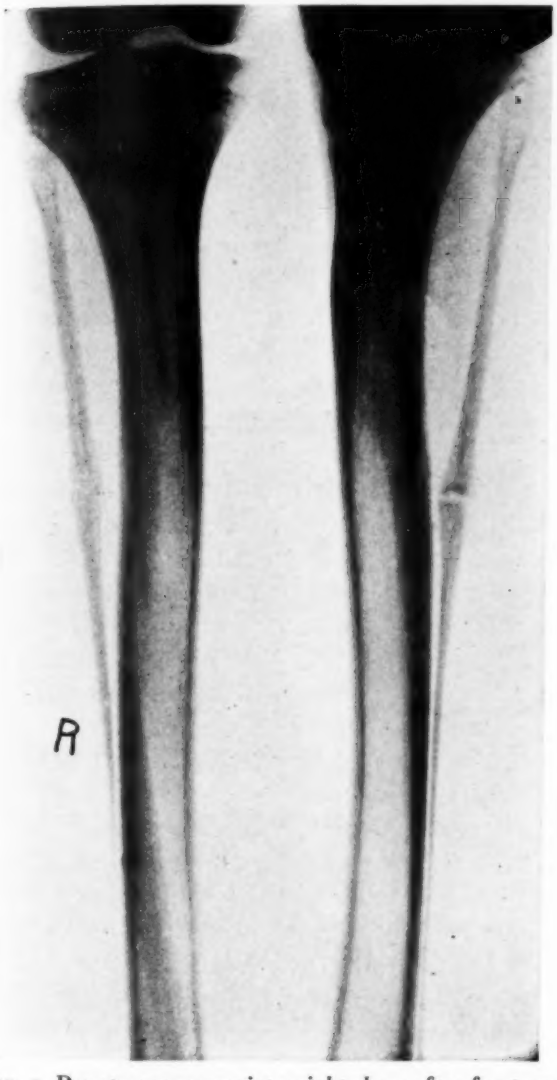

Fig. 3. Roentgenograms sixty-eight days after fracture of the fibulae and fifty-seven days after a right lumbar ganglionectomy. Definitely more repair on the right side. (Dog 9.)

Fig. 4. Left lumbar ganglionectomy nine days before fracture of the fibulae; definitely more repair on the left side. (Dog 3.)

Ito and Asami[7] mention the experimental work done in their laboratory by Uno on the effect of interruption of the sympathetic apparatus on the healing of experimentally produced fractures in dogs. Uno fractured both hind limbs in 25 dogs, and in 13 animals followed this with the unilateral operation of Leriche, and in 12 animals followed the fracture with removal of the sympathetic chain between the second or third lumbar and the first sacral region on one side. He obtained pronounced acceleration of the healing process in 6 animals, moderate acceleration in 5 animals and no definite benefit in the remaining 2 animals in the group in which the periarterial sympathectomy of Leriche had been done. There was a definite

enhancement of the healing of the fractures in 11 of the 12 animals in which a lumbosacral sympathectomy had been performed. Uno concluded that the lumbosacral sympathectomy produced a more marked and constant beneficial result than periarterial sympathectomy.

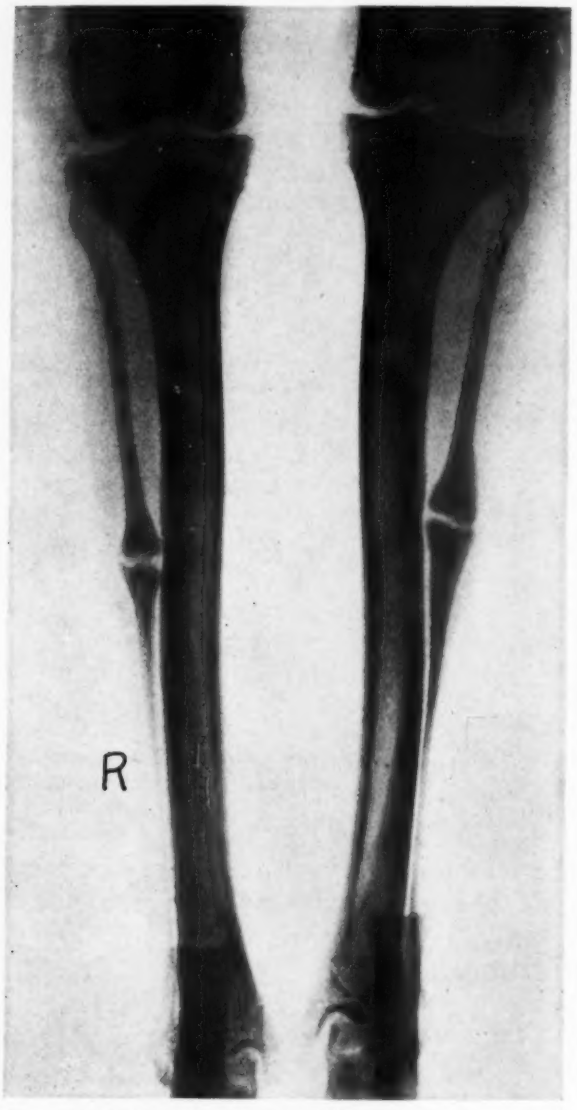

Fig. 5. Left lower lumbar ganglion removed one week after fracture of the fibulae. Slightly more repair on the left side sixteen days later. (Dog 12.)

Young[8] performed periarterial sympathectomy in 2 cases for stimulating bone repair, but without beneficial results. The one case was an extreme example of delayed union of a fractured tibia and the other a case of Charcot's disease of the knee joint in which bone ankylosis did not follow attempted fusion. He believed that periarterial sympathectomy was merely an adjuvant which might promote local activity and help the process of bone repair. Colp and Maze[9] performed periarterial sympathectomy in 7 recent fractures of the lower extremity. They obtained clinical union on an average of eleven days earlier than in a series of what they considered to be comparable fractures treated without periarterial sympathectomy. Furthermore, they obtained healing in 8 out of 10 cases of delayed union in fractures of the lower extremities which had remained ununited on an average of seventy days before operation. Clinical union in these cases occurred on an average of twenty-one days after the periarterial sympathectomy. Recently, Pearse and Morton[10] studied the effects of venous, arterial and vasomotor changes on the healing of experimentally produced fractures in dogs. They found that lumbar ganglionectomy had only a slight beneficial effect in 3 of 10 animals in their series.

During the course of our experiments the investigations of Pearse and Morton were published. Despite the fact that both the object and the methods of their study were similar to those of this investigation, it was felt that further studies were warranted. The effects of variation in the level of section of sympathetic fibers, variation in the site of bone injury, and the anatomical changes in blood vessels as shown by injection with mercury were studied.

EXPERIMENTAL PROCEDURE

Dogs were used in all the experiments. The fibula was selected for injury because it was accessible and the tibia acted as a splint. The animals were able to walk without splints or constricting bands which might have altered the circulation to the extremity. A segment of the fibula, measuring 3 mm. in length, was removed subperiosteally from each side at the same level. The resection was made in the upper third of the fibula in 4 animals; in the middle third in 7 animals, and in the

lower third in 4 animals. This was done to determine whether the effects of lumbar ganglionectomy were more pronounced

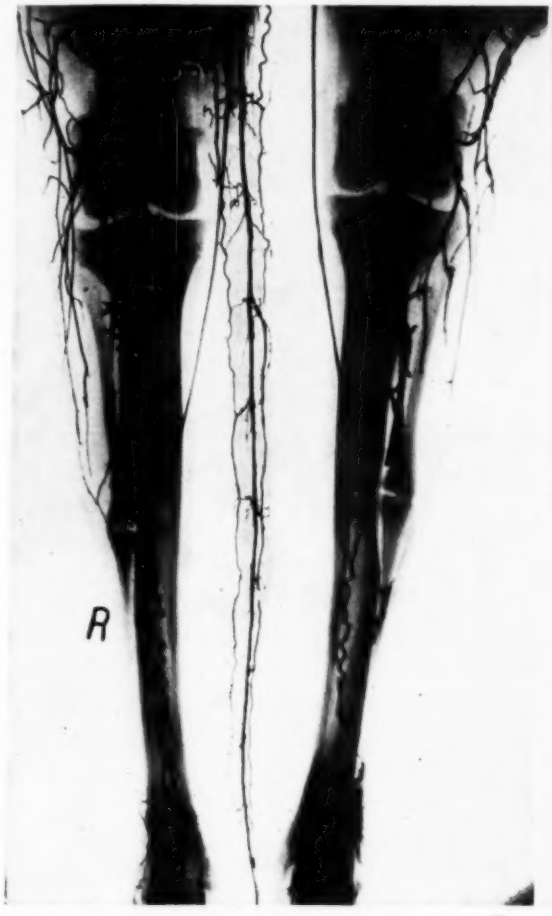

Fig. 6. Arterial injection nineteen days after removal of the left lower lumbar ganglion. (Dog. 12.)

Fig. 7. Arterial injection fifty-seven days after a right lumbar ganglionectomy. More healing on the right side, but more vessels are filled on the left. (Dog 8.)

near the periphery. The animals were discarded if the wounds became infected.

We were not careful about the periosteum in two of the early experiments. In the first experiment the fibulae were fractured with a sharp chisel in a manner similar to supracondylar osteotomy of the femur, while in the other the bone was divided with a Gigli saw. The injury to the bone was made at the same level in the upper third of both fibulae.

The lumbar sympathetic chains in dogs lie beneath the major abdominal vessels and on the lumbar vertebrae (Fig. 1). We found that the lumbar ganglion was usually large and rested just above the brim of the pelvis. The chain on both sides was thicker from the lower ganglion on down into the pelvis. The two sides united in the pelvis forming a series of closed loops which gradually became smaller. There was considerable variation in the sympathetic chains above the lower ganglion. Often the next two lumbar ganglia were very small and consisted of a slight thickening of the chain with several rami passing downward between the vertebral bodies and upward to the large vessels, while in others the branches arched from one lumbar interspace to the other. A large ganglion was usually found at the level of the renal vessels or just before the chain passed under the diaphragm.

We used a transabdominal approach in our experiments. The peritoneum was

incised near the vena cava or aorta, depending upon which chain was to be removed, and the major vessels were retracted from the midline. The sympathetic chain was found by blunt dissection.

In seven of our experiments only the large lower ganglion on one side was removed to determine if this was as effective as a more complete removal of the chain. Two, and sometimes four, lumbar segments were removed from one side in 10 of the animals. The right lumbar chain was interrupted in 7 of the animals, and the left in the remaining 10.

The lumbar chain was interrupted in 14 animals six to twenty days after the bone injury. In 3 animals it was done nine, thirteen, and thirty-four days respectively before the bone injury. This was done to avoid any initial or temporary effect which interruption of the sympathetic chain might have had on the circulation.

Roentgenograms were taken at the time of bone injury and on an average of every two weeks thereafter until the regeneration of bone was interpreted as well advanced or completely healed on one side. In the majority of the experiments the animals were eventually sacrificed and the fibulae removed for confirmation of the roentgenograms.

TABLE 1

Dog	Site of Bone Injury	Time of Sympathectomy		Extent of Sympathectomy	Healing	
		Before Fracture (Days)	After Fracture (Days)		Right	Left
1	Resection in upper third	34	..	Right lower ganglion	+	
2	Fracture in upper third	13	..	Right lumbar chain	++	
3	Fracture in upper third	9	..	Right lumbar chain	....	++
4	Resection in upper third	..	7	Left lumbar chain	++	
5	Resection in upper third	..	7	Left lower ganglion	....	+
6	Resection in upper third	..	6	Left lumbar chain	....	+
7	Resection in middle third	..	5	Right lower ganglion	+	
8	Resection in middle third	..	6	Right lumbar chain	+	
9	Resection in middle third	..	11	Right lumbar chain	++	
10	Resection in middle third	..	7	Left lumbar chain	++	
11	Resection in middle third	..	7	Left lower ganglion	....	+
12	Resection in middle third	..	7	Left lower ganglion	....	++
13	Resection in middle third	..	7	Left lumbar chain	....	+
14	Resection in lower third	..	9	Right lower ganglion	+	
15	Resection in lower third	..	20	Right lumbar chain	+	
16	Resection in lower third	..	6	Left lumbar chain	....	+
17	Resection in lower third	..	18	Left lower ganglion	....	+

+ Indicates slightly greater regeneration.
++ Indicates definitely greater regeneration.

RESULTS

The series of roentgenograms were studied by several observers not concerned with the investigation. They selected the side showing the greater regeneration of bone and this coincided with the side of ganglionectomy in 15 of the 17 experiments, regardless of the method of injuring the bone or of the time and extent of the ganglionectomy. As shown in Table 1, there was definitely more regeneration of bone opposite the side of ganglionectomy in 2 animals (Fig. 2). The regeneration of bone was only slightly accelerated on the side of ganglionectomy in 11 of the experiments. In 4 animals the difference was definitely in favor of the side on which the sympathetic chain had been interrupted (Fig. 3).

There was little difference in the rate of regeneration at the various levels. Injury of the bone in the upper or the middle third of the fibula seemed to be repaired faster than injury in the lower third. It was difficult to remove a segment of bone from the lower third without considerable injury to the periosteum and this may partially account for the prolonged period of repair.

The regeneration of bone was definitely advanced on the side of lumbar ganglionectomy in which the chain was interrupted nine and thirteen days before the fracture (Fig. 4). There was only a slight difference in favor of the side of ganglionectomy in the animal in which the lumbar ganglionectomy had preceded the bone injury by thirty-four days. Apparently the changes produced in the circulation by lumbar ganglionectomy persist in sufficient amount to hasten the repair of bone for at least thirty-four days.

Removal of the one lower ganglion in 7 animals produced a slight acceleration in the regeneration of bone on that side. The removal of the one ganglion was as efficient in the hastening of bone repair as a more extensive recession of the sympathetic chain (Fig. 5).

Horton and Craig[11] removed several lumbar ganglia in 3 dogs and allowed the animals to survive varying periods of time. The animals were eventually given ether and sacrificed by exsanguination. The arterial tree of the lower extremities was then visualized by an injection of mercury into the aorta. They found a definite anatomical increase in the size of the arterial bed on the side having the ganglionectomy. They performed a periarterial sympathectomy in one animal and later injected the arterial tree with mercury but were unable to demonstrate a difference on the two sides. They concluded from these experiments that lumbar ganglionectomy does produce an anatomical increase in the size of the arterial bed, while periarterial sympathectomy does not. We injected the aorta of 9 animals with mercury under similar conditions without finding a definite change in the anatomical bed as shown in roentgenograms (Figs. 6, 7, 8). In 7 of the animals there was evidence of faster regeneration of bone on the side having the lumbar ganglionectomy.

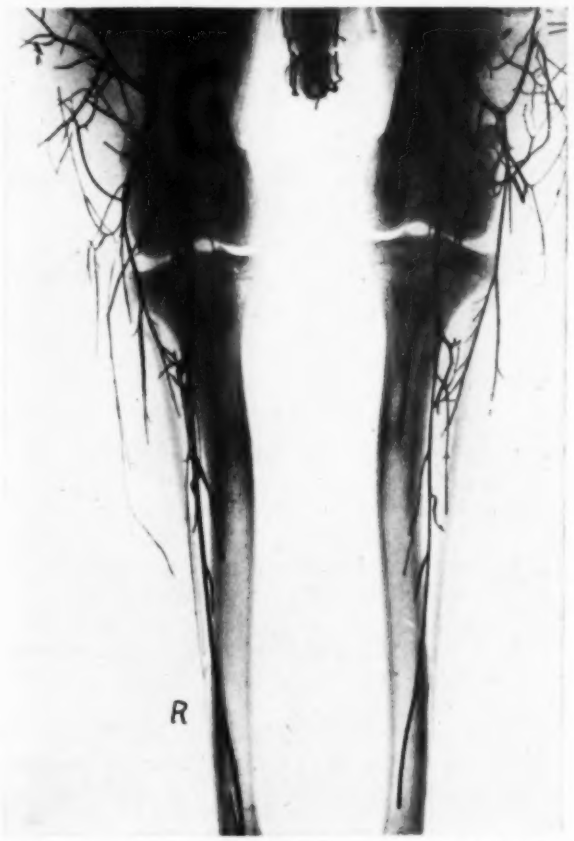

Fig. 8. Arterial injection 116 days after a left lumbar ganglionectomy. Fibulae fractured in the lower third 122 days previously. (Dog 16.)

SUMMARY AND CONCLUSION

1. The removal of one or more of the lumbar ganglia in dogs hastened the regeneration of bone in 15 of 17 animals. This acceleration of bone repair was slight in 11 animals, definite in only 4 animals, and in 2 there was definitely more regeneration on the side opposite the ganglionectomy.

2. Bone injury in the upper and middle third of the fibula seemed to be repaired faster than that in the lower third.

3. The regeneration of bone was accelerated in 3 animals in which the sympa-

thetic chain was interrupted nine, thirteen and thirty-four days before the bone injury.

4. The removal of one lower lumbar ganglion in 7 dogs was apparently as effective in hastening the repair of bone as a more complete resection of the chain.

5. There was no anatomical increase in the size of the arterial bed following lumbar ganglionectomy in 9 dogs in which the arterial bed was visualized by mercury. The injections were made nineteen to 114 days after the ganglionectomy.

6. Although these results cannot be applied directly to the treatment of ununited fractures in patients, it is suggested that interruption of the sympathetic nervous apparatus is not of sufficient value to warrant clinical application in such cases.

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"HE'S GOT A BACK"

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THE introduction from the attending physician when referring a patient who complains of an injury to his back may usually be summed up in the words "he's got a back." This expression tells nothing in itself but actually it implies that the patient deserves a detailed physical analysis. Far too often we are prone to listen to the story of a relatively minor accident, punch the back a little, find a little tenderness but apply some adhesive straps, and send the patient on his way with the assurance that he has sprained his back or torn some ligaments, and that it does not amount to anything, only to find months later disabling factors that have a marked irreparable influence on his productivity as a wage earner.

Textbooks and literature abound in descriptions of gross injuries and deformities of the vertebral column due to severe accidents, but relatively little is said in regard to the technique or proper examination to follow that may lead to the discovery of minor conditions that are frequently overlooked during the ordinary cursory examination. It is indeed too bad that so many fractures of the vertebral column are missed. As a matter of fact fractures of the vertebra without paralysis or symptoms of nerve irritation that are recognized early are relatively simple conditions to treat and usually give remarkably satisfactory results with relatively little ultimate permanent disability. Usually pronounced evidence of injury and fracture is so apparent and profound symptoms of cord and nerve injury are so evident, that such cases when confirmed by adequate examination usually receive intelligent treatment of a conservative nature that bring results of satisfactory character. Those cases complicated by paraplegia, paralysis of the lower extremities, trunk, or upper extremities, always open the question of whether the possibility of operative interference is advisable, but this point will be discussed later.

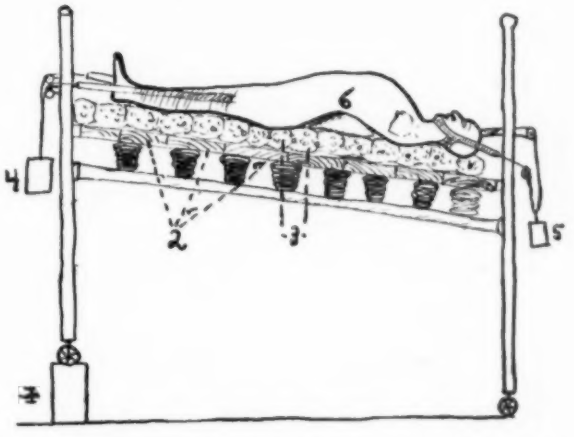


FIG. 1. Fractures of vertebra. Cartoon illustrating method of applying traction and hyperextension of thigh in fractures of vertebra. 1. Foot of bed elevated. 2. Cross planking between springs and mattress to prevent sagging with body weight. 3. Firm mattress. 4. Traction on lower extremities by use of traction straps. 5. Counter-traction for weight of body, or traction on head. 6. Hyperextension of back by means of pillows, sand bags, linen or other hyperextension apparatus. 7. Fractures below mid-dorsal region are treated as illustrated. 8. Fractures of upper dorsal cervical region are treated by elevation of head of bed, traction on head with shoulders elevated from mattress and head back.

Numerous authors have called attention to the remarkable number of spine fractures that are not recognized until late. Of 82 cases of fractures of the spine reported by Wallace, 67 gave a definite history of injury of the spine in connection with their accident; 20 of these cases were promptly recognized, 75 per cent of which showed paralysis; 47 cases were unrecognized, 3 of which, or 6 per cent, had paralysis in some degree. The shortest lapse of time of unrecognized cases was twenty-five

days, the longest 1,045 days, an average of 311 days. A single vertebral body was crushed in 60 cases; more than 1 in 21 cases. These unrecognized cases cannot necessarily be classified with the grouping of Kümmel's disease, but are cases that are overlooked on account of insufficient examination and inadequate analysis of the case.

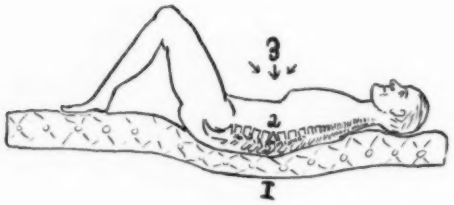


Fig. 2. Fractures of vertebra. Cartoon illustrating how kyphosis is encouraged when a soft mattress is used with no cross boards or support between springs and mattress. Arrows indicate forces of pressure possibly against fractured body of vertebra and against spinal canal. 1. Compression of soft mattress. 2. Compression and kyphosis of fractured first lumbar vertebra. 3. Arrows indicate forces of pressure against injured vertebra.

These statistics, with those of others, have led us to consider every patient who "has a back" as one who possibly has fractured his back; therefore we carefully go into the history of the case as to what previous injuries or trouble he might have had in the back, always questioning in regard to how the accident occurred, what position his back was thrown into, how forces of stress were brought to bear; if the spine was brought into acute flexion or jackknife, if a heavy body had struck the back, shoulder or head; if he has had a fall from any height whatsoever; had there been forcible twisting or torsion; a sudden jerk of the torso; or unusual lift or hold to maintain. Every possible factor in regard to the accident is considered. We inquire if at the time of first aid he had an adequate examination; if there had been a diagnosis of sprain or strain of the back; whether there was a period of unconsciousness; inability to use the extremities, or any unusual sensations in the extremities, resultant pain or tenderness in the back, persistent or remittent. All of these factors must be given due consideration.

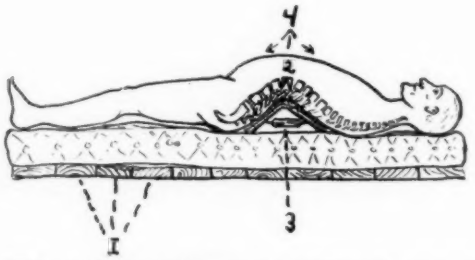


Fig. 3. Cartoon illustrating effect of hyperextension on injured vertebra. Note hyperextension apparatus which causes separation of vertebral bodies and makes possible more normal contour of injured structures. 1. Cross-boards under firm mattress. 2. Pressure relieved against body of fractured vertebra, allowing opportunity to assume more normal contour. 3. Hyperextension apparatus. 4. Arrows indicate forces of pressure away from body of injured vertebra, giving more normal contour.

Our profession is held strictly accountable for its shortcomings, oversights, lapses and neglect, therefore it behooves us to protect our position by utilizing every possible clinical and mechanical means to effect an adequate diagnosis in every case of injury to the spine.

Since spine injuries are increasing, our interest in the subject has become more acute, but failure to find pointed physical evidence of gross deformity too often allows us to carelessly waive a thorough analysis of all clinical and physical findings. My plea, therefore, is for a thorough examination of every patient who says he "has a back." No matter how far-fetched, incoherent or elusive the history may prove, if there is the least possibility of bony injury to the back every endeavor should be made to prove or disprove the point conclusively.

TECHNIQUE OF EXAMINATION

1. It is necessary to have the patient strip. Most of these doubtful patients are ambulatory and can sit or stand. The examination should begin preferably from the standing position.

2. With his back to you, have the patient point out the area of tenderness, where his back hurts, and how it feels. If his discomfort is pronounced allow him the privilege of sitting.

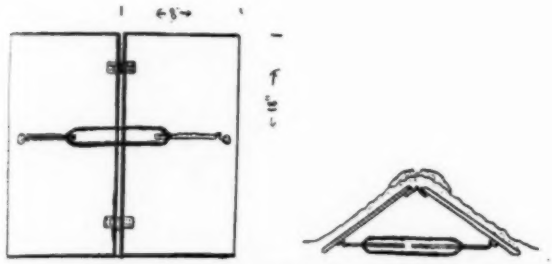


Fig. 4. Hyperextension apparatus which has proved satisfactory for gradual reduction of fracture deformities of vertebra and to obtain hyperextension of spine. It is made of sheet aluminum, 16 gauge. Two leaves are each 18 in. by 8 in. Wide sides hinged by two hinges leaving a half inch open space between them. A 6 or 8 inch turn buckle is attached by hooks rivetted to aluminum leaf about an inch in from edge at point midway of wide side. Hook should be long enough to allow leaves to lie almost flat when turn buckle is extended. Heavy felt pad reinforced over hinged portion is glued to upper surface. This apparatus in its flat position is placed under back of patient in region of fracture or where hyperextension is desired. Attending physician or attendants several times daily can give turn buckle a few twists, increasing hyperextension so that at end of third, fourth, or fifth day complete hyperextension is obtained with relatively little discomfort to patient during process.

3. Look for lists or tilting of the spine, gross deformities, curvatures, muscle rigidity and spasm, localized swelling, hemorrhage in the tissues, prominences, or anything of an unusual nature that presents itself.

4. Localize by palpation and pressure the points of tenderness, whether in the region of a particular spinous process or out towards the lamina or transverse processes. Localize the rigidity or muscle spasm; confine its extension up and down the back and out towards the abdomen or chest. Palpate as much of the entire contour of the vertebral prominences as presents, bringing out where unusual sensations of pain or discomfort are found. On thin individuals the lamina and transverse processes can be distinctly palpated. Tap the vertebral spines with a percussion hammer or with your finger or knuckle to determine the amount of force necessary to cause discomfort or pain. Sometimes crepitus can be elicited. Such evidence

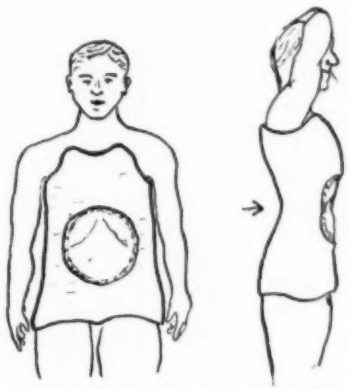
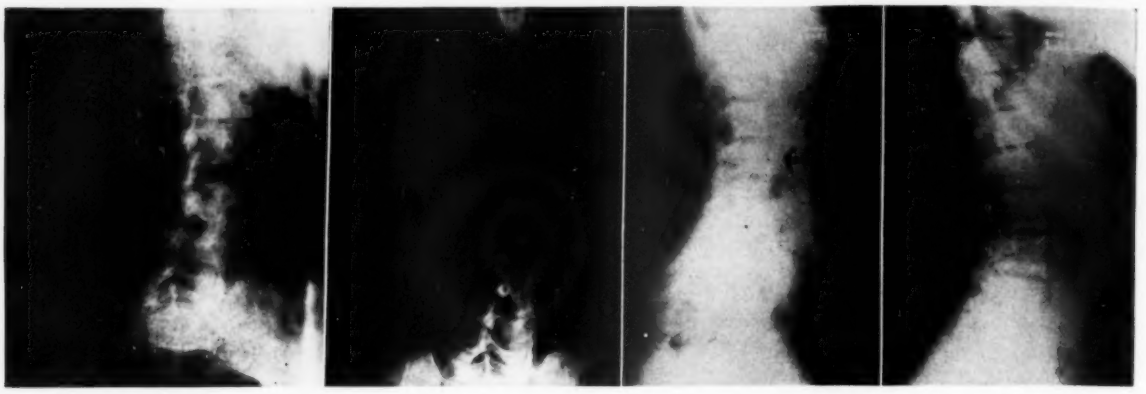


Fig. 5. Plaster-of-Paris body cast used in fractures of lower dorsal and lumbar region. Arrow points to hyperextension which it is essential to maintain during period in which patient is wearing fixation apparatus.

when once discovered should be guardedly investigated as inestimable damage might result if lamina or pedicle is involved in the fracture. The mobility of the spine and the effect of motion should be very carefully studied. If there is a history of previous injury to the spine there may be limitation of motion due to that. The back should be tested through all the normal range of activity and notation made of painful motion and how far the motion can be carried without pain. When there is pain it must be localized: whether in the spine, abdomen or chest. If the injury seems to be localized in the lower lumbar and sacroiliac region all the tests known for differentiation or differential diagnosis should be applied. No matter how minor the injury, reflexes should be carefully checked; sensation should be checked, as well as the motor power of the extremities. If there are positive findings in the lower dorsal or upper lumbar region always be suspicious of fracture for here are found most of the fractured vertebrae.

After such a routine is followed the examiner will have sufficient data to aid greatly in the estimation of what the value of the *x*-ray examination will be. One can determine with relative accuracy the parts

of the back that should be *x*-rayed, but when in doubt the entire spine should be roentgenographed. The *x*-ray examination removed (which, by the way, was perfectly normal in appearance) and with the continuance of the pain gastrointestinal *x*-ray



A B C D

FIG. 6. Case 1. A. Anteroposterior *x*-ray of spine, July 3, 1929. B. Anteroposterior *x*-ray of spine, July, 1931. C. Lateral *x*-ray of spine, December, 1929. D. Lateral *x*-ray of spine, April 11, 1930.

is of profound importance in comfirming a diagnosis and in bringing out the character of the involvement. Stereoscopic as well as antero-posterior and lateral views are essential when there is cord or nerve involvement, as the third dimension is of great help in determining the effect of bone pressure of the fragments on nerve structures. Most of the fractures occur between the eighth dorsal and the fourth lumbar and in this region they are most often overlooked because there is less possibility of nerve involvement and paralysis[1] even when there is quite extensive crushing and injury. The spinous and transverse processes are more often injured than is supposed but the commonest type of injury is the crushing of the body of the vertebra. A patient acutely injured and complaining of back pain should be very carefully handled as inestimable damage may be done, and paralysis even follow, if too much manipulation and handling occur.

Symptoms may be lacking but most of these patients prefer to lie flat and relax the muscles. Sitting ordinarily causes them some distress. Pain may be referred, due to irritation of the nerve roots, to the abdomen. I recall recently a patient that came to the operating room, had his appendix examination revealed a fracture of the body of the tenth dorsal vertebra.

We so often find patients with back injury that have very rapid recovery from their symptoms, and months later have a deformity develop in the region complained of at the time of his injury along with disabling symptoms. *X*-ray examination then reveals the fact that there is evidence of a compression of the vertebra. This syndrome was described by Kümmel in 1897 and carries his name. We are profoundly apprehensive of the development of Kümmel's disease, and believe that when there is sufficient evidence of soft tissue trauma in the region of the vertebra and a positive history of injury we are justified in protecting the back and giving the patient much the same type of treatment and protection against deformity as we would a patient with a fracture of the transverse process or a minor injury to the spine. It would be far better for these patients to wear a protective jacket or brace for several months than to have them become markedly disabled because of not having such a protection. It must be understood that such a procedure is followed only when there is very extensive soft tissue damage in the region of the vertebra. In other words, the entire picture must be

that of a fracture of the vertebra without any roentgen evidence.

With the evidence of cord injury and paraplegia, stereoscopic roentgenograms of the region involved are of extreme importance as they will often show evidence of bony pressure and irregularities in the spinal canal. Lumbar puncture is of value in determining the pressure of the spinal fluid and the presence of blood with increased pressure will help in determining whether there is a subarachnoid block or hemorrhage in the dural canal. However, if the treatment is adequately carried out from the beginning, operative intervention need not be considered until the patient has recovered from shock and the diagnosis sufficiently established. Only when there is definite evidence of bony pressure on the spinal cord, that has not been irreparably traumatized and destroyed by the accident, should laminectomy be performed.

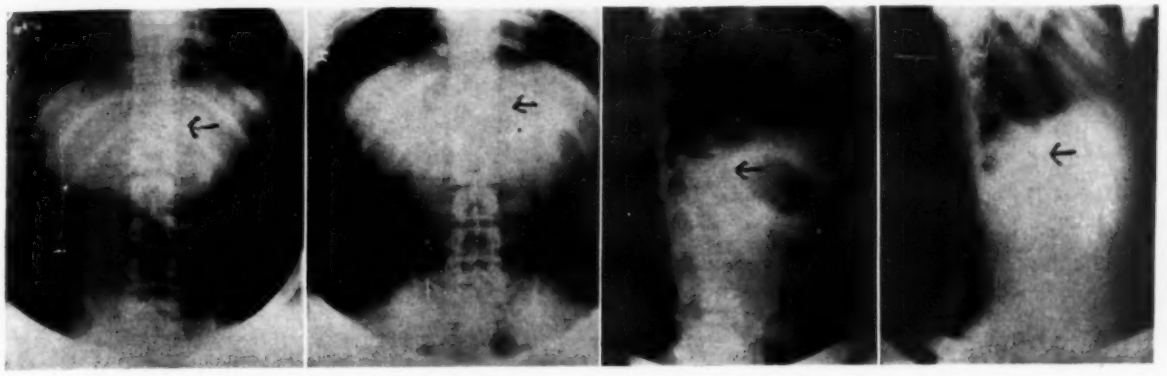


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Fig. 7. Case II. A. Anteroposterior *x*-ray of spine, May 3, 1929. B. Anteroposterior *x*-ray of spine, November 19, 1931. C. Lateral *x*-ray of spine, May 3, 1929. D. Lateral *x*-ray of spine, November 19, 1931.

The first important factors in the treatment are the general expectant and palliative measures for the restoration of the general well-being of the patient. In addition to this the bed in which he is to rest is to be prepared with boards across the springs under the mattress to make the surface upon which the patient lies perfectly flat. If the cervical region is involved the head of the bed should be elevated about 8 or 10 inches. If the lower dorsal or lumbar region is involved the foot of the bed should be elevated. Traction should be applied to the head if the upper dorsal and cervical region is fractured; traction applied to the feet if the lumbar or lower dorsal is involved. The amount of traction necessary is not great as the counter-traction of the body aids greatly in increasing the effectiveness of traction. Five to 10 pounds may be applied on each leg; 4 to 7 pounds to the head. In some instances it is necessary, in order to attain adequate relaxation of the spine, to apply traction on both the head and the lower extremities. Immediately the bed is built up between the mattress and the back with a well-formed wedge increasing the height until a very complete hyperextension of the spine has been produced. A small sandbag covered by a folded sheet forms a good wedge with which to start hyperextension. The bags can be increased in size to give further hyperextension. Hinged pieces of sheet metal or boards each 8 inches from hinge to edge and 14 to 18 inches wide, with a turn buckle attached beneath, covered by a pad, furnish a splendid hyperextension apparatus. As the turn buckle is brought together the hyperextension increases. This makes it unnecessary to disturb the patient as much as does the changing of sand-bag wedges during the process of gaining complete hyperextension. The accentuation of the hyperextension should be behind the injured vertebra.

The purpose of traction and counter-traction is to perfectly relax the spasm and pull of the strong muscles attached to the vertebra and the entire trunk. With the muscle relaxation hyperextension is more rapidly accomplished. The articulating portions of the vertebrae perform during the process of achieving hyperextension as the axis, widening the spaces between the bodies of the crushed vertebrae and giving an opportunity for the restoration of normal anatomical contour of the vertebral bodies, so to speak, and reducing the fracture fragments. Likewise the two factors of traction and hyperextension tend to straighten out the spinal canal, reducing to a minimum the possibility of pressure of the fragments on the spinal cord or roots. The one exception to the advisability of this procedure is a fracture of both laminae and compression of the fragment inward due to this, but with the symptoms of cord pressure and stereoscopic *x*-ray confirmation of such trauma, laminectomy is distinctly indicated. This indeed is one of the few instances when laminectomy is advisable as such a fracture often tends to depress its fragments against the cord substance.

Passive manipulative measures to effect reduction of fragments must be used guardedly and are seldom advisable in dorsal and lumbar fractures, particularly when the traction hyperextension technique, as previously described, is followed. But in the case of fracture dislocations in the cervical region, if one is thoroughly familiar with the possibilities which may lead to disastrous complications, manual reduction may be attempted by a skilled operator within a few hours or days after the injury, followed by traction-hyperextension and later a cotton collar or cast. Once complete hyperextension is accomplished and with this position maintained, the patient is placed in a plaster-of-Paris cast or shell, the type depending on the point of injury and evidence of paralysis and cord involvement. If there is no evidence of paralysis and the injury is in the usual lumbodorsal region an ordinary body cast is sufficient. But if there is paralysis of the extremities a plaster bed is advisable and thereby the entire body can be much better protected from deformity, pressure sores and human excreta.

Such patients must be elevated from the mattress by sand bags or with overhead suspension and a pan kept constantly under the patient to catch involuntary passages of feces and urine, thereby keeping the surrounding skin and cast dry. Catheterization is not advisable, an overflow or cord bladder is much to be preferred and superpubic cystotomy and permanent drainage is very often indicated.

The ordinary patient with compression, without paralysis, must remain recumbent eight weeks in the cast, then he may be made ambulatory in another cast or a Taylor back brace. Some manner of support must be worn for from three to nine months, depending upon the extent of the injury, age and general physique of the patient as well as the effect of his occupation on the healing structures.

One of the greatest problems we meet in dealing with these back injuries is to get the patient to appreciate the fact that there comes an appropriate time for him to recover and again assume his former position in society as a self-supporting individual. This is particularly true with compensation and industrial cases, or with those patients who hold some responsible individual, firm, or insurance carrier liable for their injuries. They positively refuse to give up their symptoms of pain and limitation of function until a satisfactory financial settlement is arranged or court decision has been rendered in their favor. The incidence of such cases is increasing, there-by markedly lengthening the actual periods of convalescence and the duration of disability. It often takes considerable coercion and urging to pull them out of this psychosis of inertia to a state of usefulness, but this should form a part of our reconstruction treatment.

There is another increasing group among the back injury patients that present complicating factors when it comes to obtaining a satisfactory termination of these cases. This group comprises two types, the old man in industry and the arthritic type. These are considered together because of the fact that almost all old men who suffer back injuries have arthritis, and the symptoms are relatively the same as those of the younger individual who, after an injury to the spine, develops an arthritis if he has not already evidence of this complication before the injury. More often the arthritis is responsible for more of the ultimate permanent disability in the back than the injury itself, and the questions of where the injury ends and where the arthritis begins, as well as whether or how much the injury aggravated the arthritis are often and generally difficult to answer. These are vital factors that must be dealt with in the medicolegal approach to most such cases, but it is not my intention to discuss their relative merits in this paper. My purpose in mentioning this is merely to call attention to the fact that our experience has led us to the following deductions with respect to arthritis and its relation to back injuries. First, that all old men have arthritis of the spine and have a prolonged convalescence with considerable ultimate disability for heavy labor. Second, that younger individuals, having evidence or history of chronic arthritis, usually have symptoms of it develop in the back, following fracture of the vertebra, whether it existed in the back prior to the injury or not, and therefore have a prolonged recovery and partial permanent disability. Third, those who have congenital anomalies complicating injury such as spondylolisthesis, sacralizations, lumbarizations or anomalies of the fifth or sixth lumbar vertebra are often subject to arthritic complications in the spine. Fourth, patients having acute infections complicating or directly following the fracture of the vertebra often develop osteoarthritic symptoms.

Therefore, bearing these facts in mind, we must during the course of our treatment of the fractured vertebra treat the arthritis if present, and watch expectantly when there is a possibility of its becoming a complicating factor.

The present interest in the subject of arthritis and its relation to these injuries opens a field of possibilities for the traumatic surgeon to be alive to, and all the talent available should be used to shorten the convalescence and decrease the disability. We feel that much is gained for these patients by rest and diet, general upbuilding, correction of metabolic disturbances, removal of foci of infection and most important of all is the use of autogenous vaccines of streptococci to which the patient is sensitive, given in such very small doses that no deleterious, local, focal or general reactions result during the treatment. Such well-rounded treatment we believe has arrested distressing symptoms of arthritis and reduced the ultimate partial permanent disability of many such patients.

The foregoing deductions with regard to back injuries and the importance of their adequate diagnosis and treatment is the result of a survey of 532 patients, covering a ten year period, each of which was satisfied that he "had a back" as the result of an accident. The history and symptoms were sufficiently significant to justify complete analysis of the case. A summary of the findings in this series of backs follows. However, in considering their relative value and their variance with those of other contributors to the subject of back injuries, one must take into consideration the fact that this series comes from a private orthopedic or bone and joint clinic which draws much of its clientele from physicians who see fit to refer such injuries of unusual, serious or of obscure nature to such a clinic.

There were 220 fractures of the vertebra. In this number are included fractures of the processes of the vertebrae, fractures of the sacrum and coccyx, and traumatic

spondylolisthesis. Of these 172 were male and 48 were female.

There were 312 sprains and strains of sufficient gravity to cause the diagnostician to suspect fracture of the bony structures of the back and of these 186 were male and 126 female.

The diagnoses fell under the following classifications:

Diagnosis	Number	Male	Female
Fracture of cervical vertebra	29	21	8
Fracture of dorsal vertebra	42	30	12
Fracture of lumbar vertebra	102	84	18
Fracture of coccyx and sacrum	29	14	15
Spondylolisthesis, traumatic	18	13	5

The 312 patients without evidence of fracture of the vertebra were classified under the following groups:

	Number	Male	Female
Injury to cervical region	9	5	4
Back strain or sprain	100	69	31
Sacroiliac strain or sprain	145	72	73
Lumbosacral strain or sprain	58	40	18

The interesting features of this summary study are: (1) the large number of fractures of the back in relation to the total number of back injuries reviewed. However, this is not an unreasonable relation when we consider that in a specialist's private clinic the unusual and obscure cases are so often sent for diagnosis and treatment. (2) The proportion of women with fractures of the back to that of men (172 male, 48 female, ratio of 2½ men to 1 woman). But when we recognize the fact that most of our accidents are caused by the automobile, including street and road catastrophies, and there is unfortunately a woman involved in practically every auto accident, these figures are not absurd.

ILLUSTRATIVE CASES

Case 1. Miss H. M., aged seventeen, on July 1, 1929, was riding on the fender of a car when the car hit a bump and threw the girl into the road and the car passed over her torso. She had a complete paralysis from the pelvis down. The accident occurred two days prior to her admission to the hospital. *X*-rays were taken immediately upon her arrival and it was found that she had a compression fracture of the body of the third lumbar vertebra, with considerable distortion and displacement laterally and with rotation of the entire region.

On account of the patient's condition only anteroposterior *x*-rays were made on first examination. The lamina seemed to be fractured, even dividing the spinous processes; also the transverse processes were fractured. This was described by the roentgenologist as a backward lateral dislocation of the vertebra with a very decided disturbance of the neural canal.

She was immediately placed in a bed, with cross-boards under the mattress; the foot of the bed was elevated, and traction was applied to both legs by means of adhesive straps. Hyperextension was started in the region of the fractured vertebra. In the course of three days she was placed in a complete hyperextension plaster bed, allowed to develop a cord bladder, but in spite of all the intelligent care that hospital attendants could give her, within a week or so the cast was so foul from secretion that a new cast had to be applied.

Hyperextension that was gained during the time that the corrective measures of reduction and extension were applied, was maintained in the cast as it was applied.

X-rays taken after the first cast was applied showed considerable restoration of position in the vertebra and entire relaxation in that region. These, of course, were stereoscopic examinations. There was still a moderate scoliosis but the neural arch seemed to be restored, so that when the second cast was applied we endeavored to correct some of this scoliosis and our next *x*-rays, taken two months after the accident, showed a very satisfactory recovery of normal relation between the bodies of the vertebra although the third lumbar had been very severely crushed.

After the first week she began to show some movement in the toes and gradually some more motor power came back into the lower extremities. Ultimately, at the end of four months, this young woman was walking around on crutches with her legs in braces and a Taylor back brace on her back. She made a practically complete recovery of her motor power in her lower extremities with the exception of a paralysis of the tibialis anticus group with resulting toe

drop deformity. Bladder and rectum functioned normally in five months.

On March 2, 1931, a Campbell calcaneal block operation was performed on the right foot which was the more disabling of the two, and as a result, four months later, July, 1931, she was well enough to marry and is now the mother of one healthy child.

This was one case on which some would have performed a laminectomy to relieve pressure on the cord, but in this instance, which is illustrative of others we have had, reduction of the deformity by traction and hyperextension has removed the pressure on the cord, allowed the spinal column to heal in a normal posture and finally saved the patient from the danger of a surgical procedure. (See Fig. 6.)

Case II. J. H., aged twenty-four, lineman, who fell from pole, 30 feet. Walked about afterward and worked through the day. Walked to hospital the following day.

Negative findings save for tenderness in lower dorsal region. Slight kyphosis. Complained of pain on active movement of spine. Without close check-up of physical findings this case might have been overlooked, but the lateral *x*-rays show compression of the 12th dorsal vertebra, which was corrected by traction and hyper-extension of the spine. Recent *x*-rays (Fig. 7B and D) show complete restoration of vertebra. Four months after the accident he returned to light work. Seven months after the accident he was doing full work with no disability. (See Fig. 7.)

EIGHT COLON CASES

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WE herewith present resumés of eight interesting colon lesions which we have seen during the past four-

FIG. 1. Case 1. Adenocarcinoma of cecum.

teen years. Brief case histories of these patients will be given, followed by a summary.

CASE 1. Mrs. M. G., aged forty-four, occupation, housewife.

Mrs. G. presented herself at our office March 24, 1929, complaining of menorrhagia and dysmenorrhea of eight months' duration. A diagnostic currettage had been done ten days previously, and the microscopical examination revealed a well-developed carcinoma of the fundus uteri. We operated upon her the following day, and a complete hysterectomy was done. At that time the colon and liver showed no evidence of pathological changes. The patient made a satisfactory convalescence and left the hospital in good condition.

She returned to our office for examination approximately one year and ten months later, at which time she complained of severe pain throughout the abdomen, more marked on the right side. Abdominal examination revealed a mass in the region of the cecum and ileum. A barium enema was given and a large filling defect of the lower half of the cecum was noted. This was interpreted as a carcinoma of the cecum. She was operated upon January 17, 1931. An orange-sized mass was found involving the cecum. The pelvic organs, liver and peritoneal glands again showed no evidence of malignancy. An ileocolostomy was performed. Her condition progressed satisfactorily, and the second stage was performed approximately three weeks later, at which time the cecum, ascending and one-half of the transverse colon were resected. Pathological report of the specimen removed was advanced adenocarcinoma. The patient experienced a rather stormy convalescence, but finally left the hospital in good condition, although she had a fecal fistula. The fistula continued to drain until about July 1. She reported to the office August 11, at that time she was feeling fine, and the wound had completely healed.

This represents a case of adeno-carcinoma of the cecum which had been operated two years previously for adeno-carcinoma of the fundus uteri. An ileocolostomy was performed at the first operation, followed by a resection of the colon approximately three weeks later. (Figs. 1–3.)

Case II. Mrs. LeG., aged forty-six, occupation, housewife.

This patient complained of recurrent attacks of colicky pains across the abdomen followed by frequent vomiting and marked abdominal distention. There was a history of chronic constipation. Examination of the abdomen revealed distention throughout with rigidity of both recti muscles. There was a suggestion of a soft mass in the mid line below the umbilicus. Rectal examination revealed no ballooning. The patient was operated upon with local nerve block and infiltration anesthesia. When the peritoneal cavity was opened, free bloody fluid and numerous loops of small intestine presented themselves. The cecum was 5×18 inches long, and there was no mesocolon up to the middle of the transverse colon. The entire cecum and ascending colon had rotated 180° and was found under the liver. There was a definite thin band of adhesions causing angulation at the point of obstruction. The distended cecum was rotated into its normal position and a cecostomy and Weitzel enterostomy in the lower ileal segment were performed. The patient was extremely dehydrated and toxic. Hypertonic saline solution and glucose were administered intravenously and normal saline solution was given subcutaneously. She made a very satisfactory convalescence and left the hospital on the seventeenth postoperative day. A barium enema given six months later showed that the colon was normal in size and position. The patient remained in good health.

This represents a case of acute intestinal obstruction due to volvulus and rotation of the mobile cecum which was treated by enterostomy and cecostomy. (Fig. 4.)

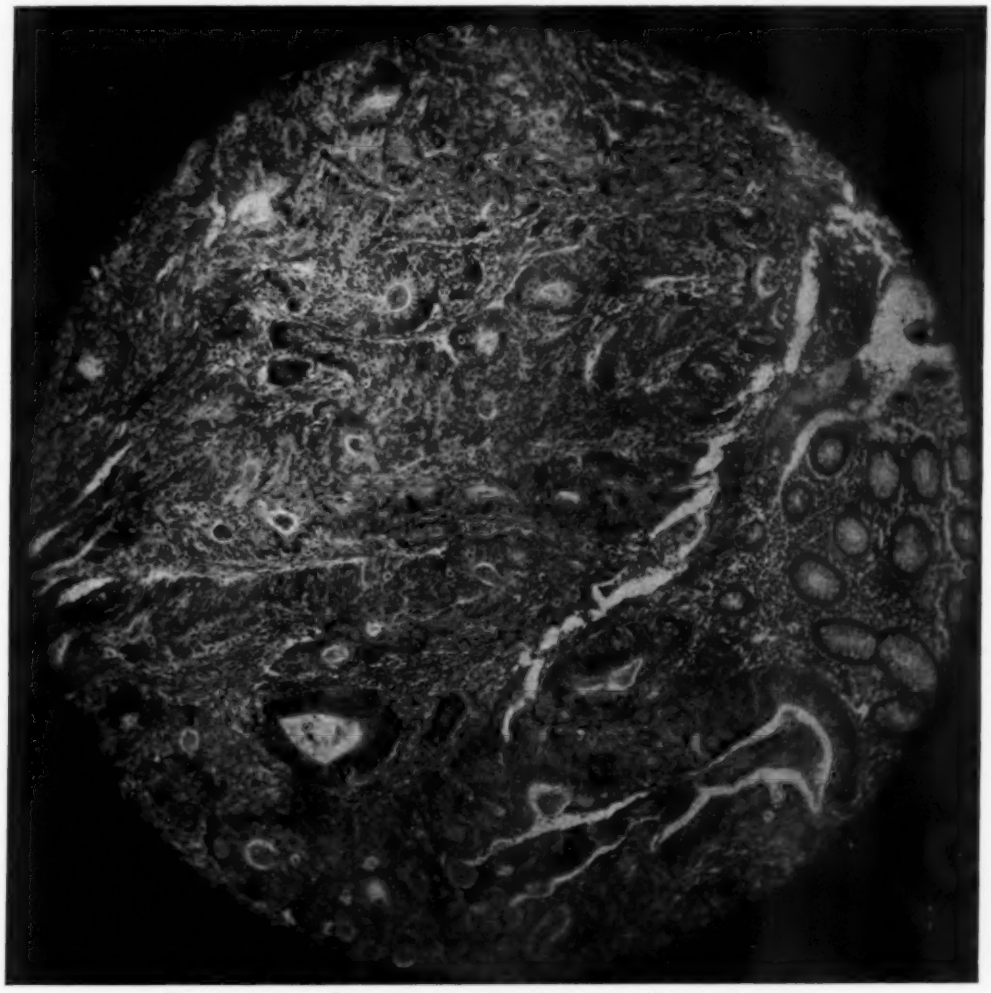


Fig. 2. Case 1. Photomicrograph of adenocarcinoma of cecum.

Case III. Mrs. J. G., aged forty, occupation, housewife.

This patient presented herself early in January, 1929 complaining of eructations of gas associated with cramps, flatus and small nodular stools, for about one year. *X*-ray studies showed a dilated cecum which was bunched with the ascending colon. There was a disturbance in the relation of the terminal ileum, suggesting old inflammation about the cecum. There was apparent displacement of the barium by a round tumor in the mid-transverse colon. The patient was operated upon March 16, 1929, under ether anesthesia. The liver was smooth in outline. A large mass was found on the right half of the colon extending well over toward the splenic flexure, which proved to be an intussusception of the cecum, terminal ileum and hepatic flexure into the transverse colon. The intussusception was carefully reduced and a large smooth encapsulated tumor of the cecal wall was found. This was near the ileocecal junction and was about 2½ inches in diameter. There was no apparent involvement of the ileocecal or mesocolic glands. A preliminary ileocolostomy was performed, anastomosing the lower part of the ileum to the transverse colon. The patient stood the operation fairly well. During her convalescence she developed a bronchial pneumonia, which promptly cleared up. She was discharged from the hospital in fair condition.

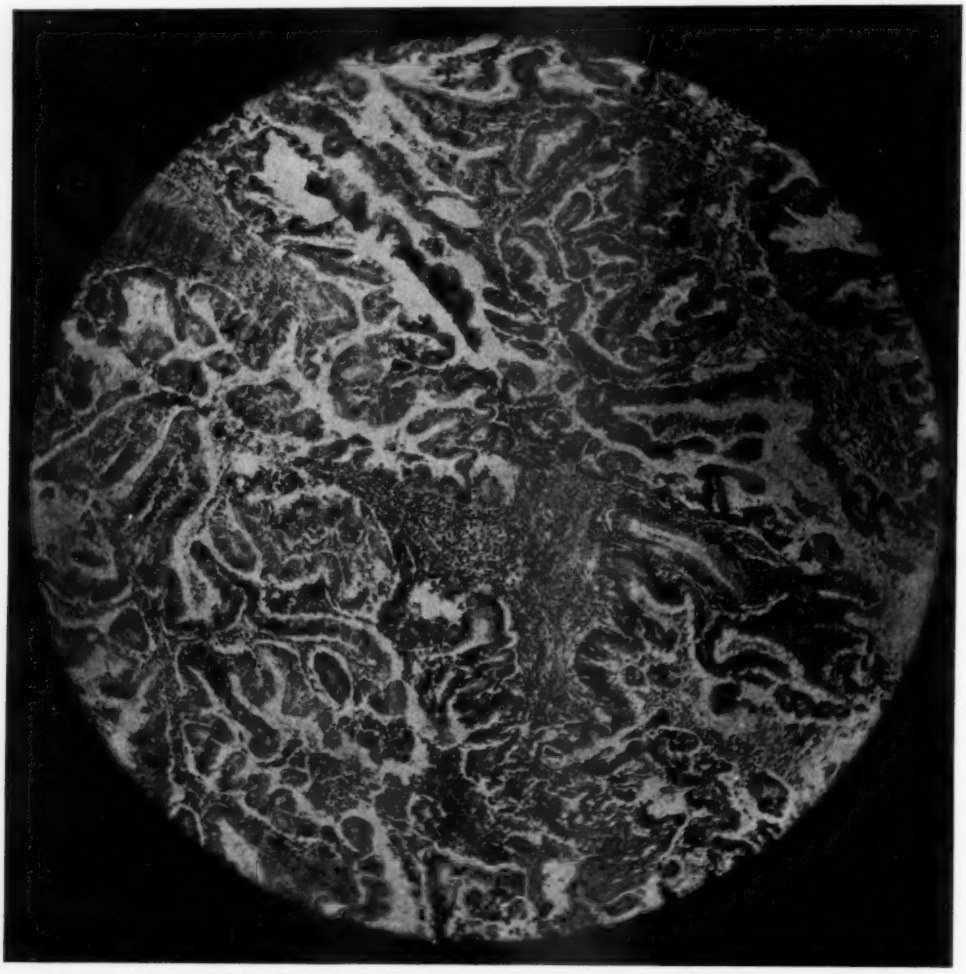


Fig. 3. Case I. Photomicrograph of adenocarcinoma of fundus from currettings.

The second stage was performed five weeks later. Under spinal anesthesia the terminal ileum, cecum, ascending and right half of the transverse colon were resected. The patient made a very satisfactory recovery. The laboratory report on the specimen removed was chronic inflammation and ulceration of the large intestine. No malignancy was found.

This represents a case of intussusception of the cecum, terminal ileum and hepatic flexure into the transverse colon, as well as an inflammatory process of the cecum. An ileocolostomy was performed followed by a resection (Figs. 5–7).

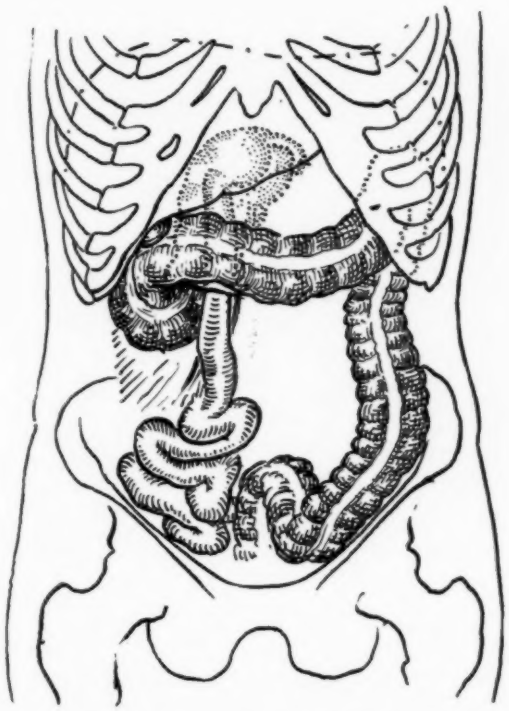


Fig. 4. Case II. Volvulus with rotation of cecum.

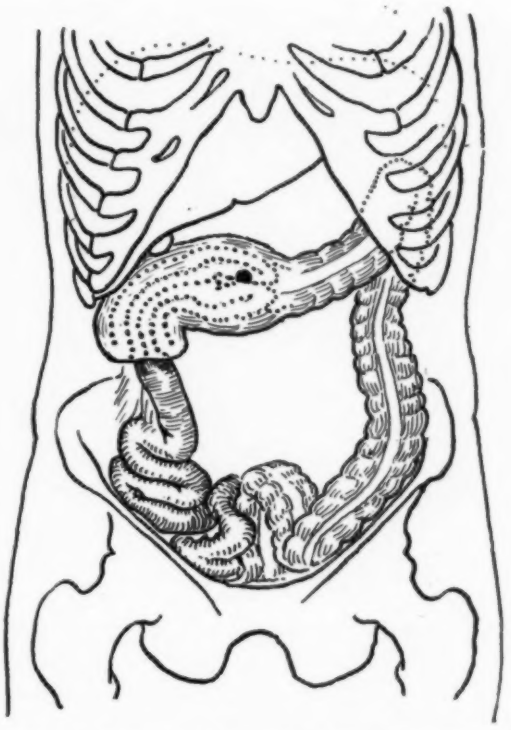


Fig. 5. Case III. Intussusception of cecum and colon. Black dot shows site of ulceration.

Fig. 6. Case III. Roentgenogram following barium enema, showing obstruction in transverse colon.

Fig. 7. Case III. Roentgenogram after expulsion enema, showing intrinsic lesion of colon.

Case IV. Mrs. J. C., aged sixty-one years, occupation housewife.

The patient entered Harper Hospital August 12, 1929 complaining of a sudden diffuse epigastric pain, associated with nausea and vomiting. The pain had a tendency to radiate to the

right lower quadrant. The past history was essentially negative. There were no serious illnesses, or previous similar attacks. On examination the patient appeared very nervous and acutely ill. The temperature was 99°F., pulse 100, and respirations 22. The abdomen showed marked right rectus muscle spasm, with extreme tenderness over McBurney's point. A white blood cell and differential count was made. There were 10,000 W.B.C. with 74 per cent polymorphonuclears, 16 per cent large lymphocytes and 10 per cent small lymphocytes. A provisional diagnosis of acute gangrenous non-perforated appendicitis was made. The patient was operated upon immediately under spinal anesthesia, with 100 mg. of novocaine crystals supplemented with gas analgesia. The appendix which was readily delivered showed mild inflammatory changes. The lumen was small throughout. It was quite apparent that this organ was not the source of the trouble. The pelvis was entirely negative. The cecum was found to be dilated and there was a soft mass which measured 1 by 1½ inches in size within the mid-portion of the transverse colon. This seemed attached to the wall, and felt like a mural carcinoma. The appendix was removed and the caput cecum was sutured to the parietal peritoneum through a stab wound. The cecum was then opened, and a catheter was inserted into it. The patient convalesced satisfactorily, and ten days later the second stage was attempted. Six inches of the mid-portion of the transverse colon were resected. Following this an end-to-end anastomosis was performed. The patient was discharged from the hospital September 18. There was a small amount of drainage from the cecostomy opening, but the patient was having normal bowel movements daily. The fistula however continued to drain, and she again entered the hospital June 17, 1930. At this time the cecum was freed from the abdominal wall, and the opening was closed by a reinforced purse-string suture. She made an uneventful recovery and has remained well.

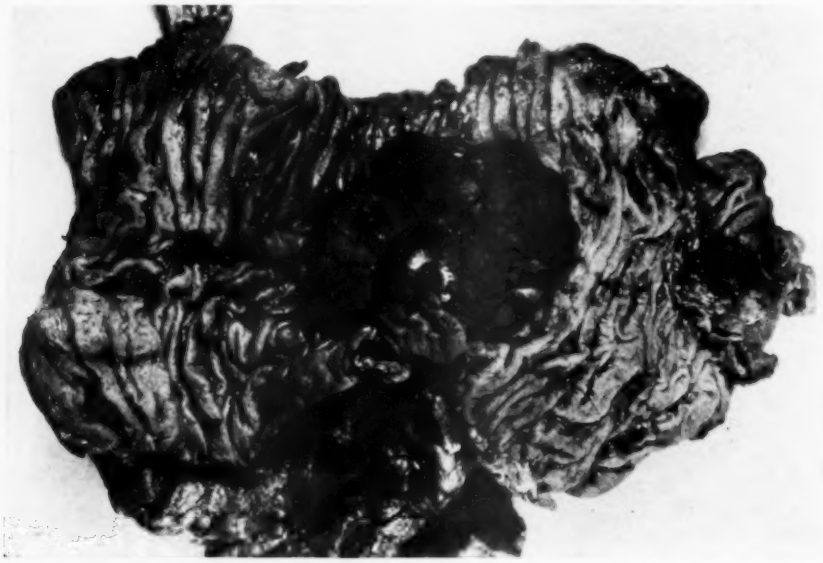


Fig. 8. Case IV. Adenocarcinoma of transverse colon.

This represents an early adenocarcinoma of the transverse colon which produced symptoms and objective signs very similar to an acute gangrenous appendicitis. (Fig. 8.)

Case V. Mr. L. C., aged thirty-eight, occupation merchant.

This patient presented himself at our office November 6, 1917, complaining of abdominal pain of 9 months' duration; nausea which has progressively become worse; and constipation of ten years' duration. A barium enema showed a distinct obstruction at the first portion of the splenic flexure with dilatation of the large bowel proximal to this point. The patient was operated upon September 27, 1917. An irregular nodular mass the size of a lemon was found at the splenic flexure. A cecostomy was performed. The patient was operated upon three weeks later and a resection of the splenic flexure was done followed by a lateral anastomosis. He progressed nicely and about two

weeks later the cecostomy fistula was closed. Pathological report of the tissue removed was advanced medullary carcinoma. The prognosis was said to be bad. The patient left the hospital November 17. He reported to the office again in April, 1925; at this time he complained of some pain in the lower abdomen and back. His general condition was satisfactory.

This represents a case of adenocarcinoma of the splenic flexure of the colon. A primary cecostomy was performed followed by a closure of the cecostomy opening. This was an advanced medullary carcinoma which carried a bad prognosis. The patient made a satisfactory convalescence and is still living and able to carry on with his regular duties. (Fig. 9.)

Fig. 9. Case v. Adenocarcinoma of splenic flexure.

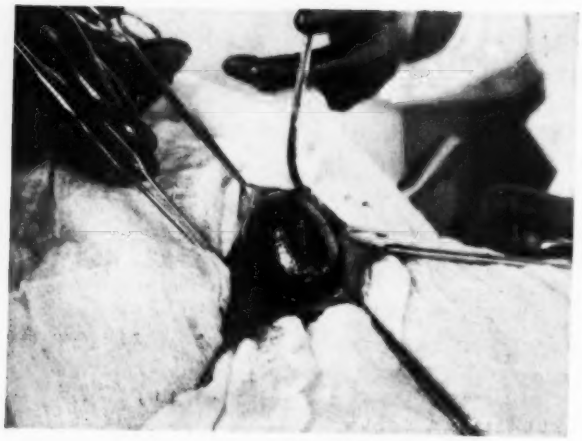
Fig. 10. Case vi. Recurrent adenocarcinoma of pelvic colon with multiple polyposis.

Case vi. Mrs. J. K., aged twenty-three, occupation housewife.

This patient came to our office August 25, 1922, complaining of severe constipation and rectal bleeding for six months. Digital examination revealed projecting hard masses about 1 to 2 inches beyond the sphincter and entirely surrounding the wall. She entered the hospital August 26, and a specimen was removed for microscopic examination. The pathological

report was advanced carcinoma of the rectum. Two days later, a left inguinal colostomy and a resection of the rectum from below was performed. We felt the prognosis was grave in this case, because of the following factors: (1) extensive growth of lesion; almost completely encircling lumen; (2) the patient's age; an individual in her twenty-third year.

A



B

Fig. 11. Case vii. Lipoma of sigmoid.

About one month later, the colostomy was closed. The patient left the hospital, October 4, 1922, in apparently good condition. She remained well, and came to the office frequently for examinations. Two and one half years later a barium enema was given and no organic pathology could be demonstrated.

In May, 1929 (six and one-half years later) she again consulted us, complaining of some diarrhea and occasional rectal bleeding. She had also lost about 10 pounds in weight. A barium enema was again given and the presence of an organic lesion of the sigmoid was readily demonstrated. This was very suggestive of carcinoma of this region. A mass could be felt about 5 inches within the anal sphincter. A specimen was removed which resembled polypoid tissue grossly.

The patient was operated upon the following day. A permanent colostomy with resection of rectum and sigmoid was done. Examination of the specimen showed two separate adenocarcinomata 4 inches apart with multiple polyposis.

This represents a case of advanced adenocarcinoma of the rectum in a young female, twenty-three years of age. The tumor was resected. The patient remained well for approximately seven years, and then developed recurrence secondary to polyposis. She was again operated and finally died of a paralytic ileus. (Fig. 10.)

Case vii. Mr. F. A. K., aged fifty-four, occupation carpenter.

The patient presented himself complaining of chronic constipation and pain on the left lower quadrant, about three months duration. The abdomen was soft, symmetrical and somewhat distended. Below the umbilicus and to the left was a soft, smooth movable mass which was quite tender on manipulation. He was operated April 17, 1923, and at the junction of the upper sigmoid and colon a soft globular mass about 8 cm. in length was found. This mass practically filled the lumen of the bowel. There was some accompanying inflammation about it. The bowel was opened, and a large lipoma with a rather broad pedicle was found. The pedicle was ligated and the tumor excised. The bowel was closed in the usual manner. Pathological report of the tissue removed was lipomatous polyp of the sigmoid. The patient made a very uneventful recovery, and left the hospital on the sixteenth day in good condition.

This represents a case of pedunculated lipoma which almost completely occluded the lumen of the sigmoid. The tumor was excised, and the patient remained well. (Figs. 11 and 12.)

Case viii. Mr. F. J. E., aged sixty-three.

This patient entered Harper Hospital, March 15, 1932 complaining of the following: Marked spasm and tenderness in the left lower quadrant; difficulty of urination; backache; chills, followed by elevation of temperature (101–102 9/10°F.). The patient's general health had been fair. There was an old history of urinary distress.

He had been seen at home about January 5, 1932, and had complained of tenderness and spasm in the left lower quadrant, extending to the groin. Constipation had been most severe. Roentgenological examination of the colon was advised at this time. Mild attacks of this have occurred at frequent intervals since. Pain and pressure in the anterior rectal wall have been quite marked, accompanied by nausea and vomiting.

Examination: The abdomen was distended throughout. There was rigidity and tenderness in both lower quadrants, most marked over the left rectus muscle. On rectal examination the prostate gland was enlarged and a questionable soft mass could be felt above it.

A white blood cell and differential count were taken. There were 20,600 W.B.C. with 90 per cent polymorphonuclears and 10 per cent lymphocytes. A diagnosis of ruptured diverticulitis with pelvic peritonitis of three days' duration was made.

The patient was markedly dehydrated.

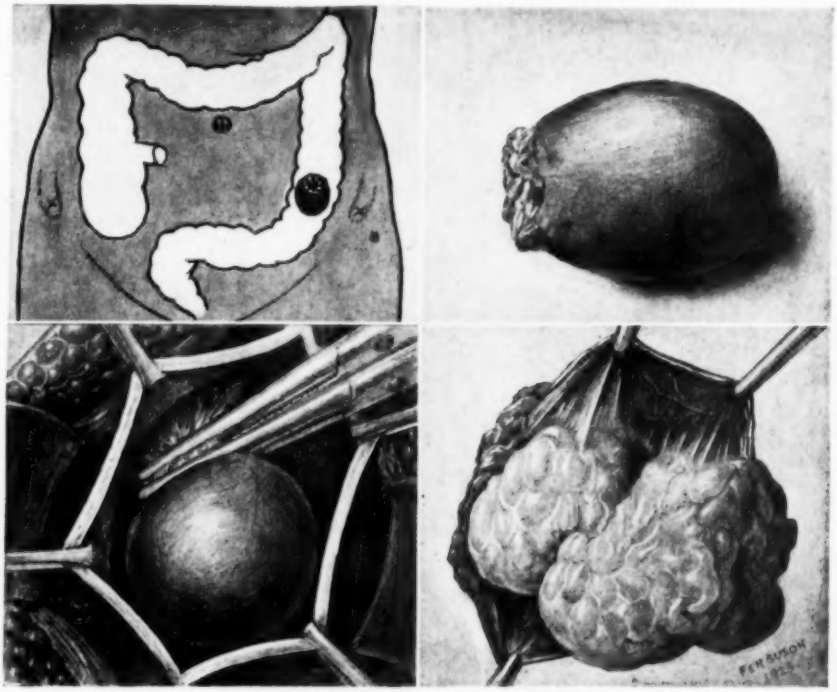


Fig. 12. Case VII. Lipoma of sigmoid.

Saline solution was administered subcutaneously and glucose intravenously. Hot stupes were applied to the distended abdomen and moderate doses of morphine were given. Operation was performed the following day under spinal anesthesia. A 4 inch low right rectus incision was made. A mass was found in the lower mid-abdomen extending more to the right side. This was inflammatory in nature and walled off a perforated diverticulum of the sigmoid. There were about 6 oz. of pus in the pelvis. The diverticulum was closed with a purse-string suture, and a free tag of omentum was sutured over this closure. The appendix was inspected. It was small and retrocecal, and apparently of no significance. A tube was placed into the cecum and fixed by three purse-string sutures. Two rubber drains were placed in the pelvis. The abdomen was closed in the usual manner.

Postoperative course: The patient reacted satisfactorily. Following the operation an immunizing dose of 5 c.c. of gas bacillus antitoxin was given intramuscularly, as well as 5 c.c. sterile milk. The dose of sterile milk was increased by

1 c.c. daily until a maximum of 10 c.c. had been given. The following day the patient was markedly distended. There was considerable

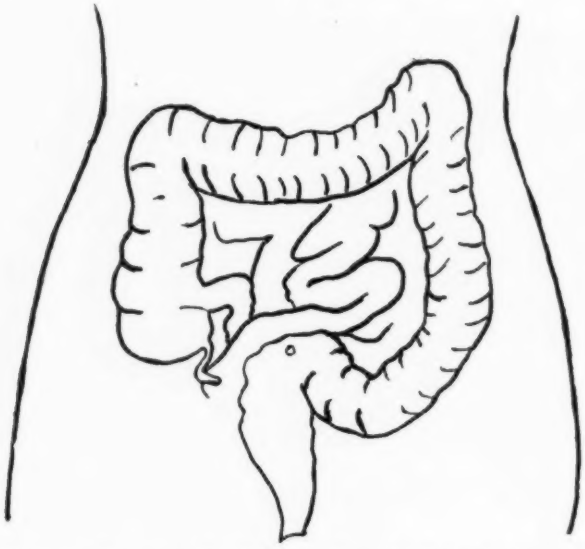


Fig. 13. Case VIII. Perforating diverticulitis of sigmoid.

nausea and vomiting and it was necessary to use the Levine tube through which 3 oz. of hypertonic saline were introduced every two hours. There was abundant drainage from the cecostomy tube. During the next four days the patient gradually improved. On April 1, at noon, he experienced a sudden severe pain in the left chest, accompanied by a slight cough, and blood-streaked sputum. Two days later he experienced similar pains in the right axilla. Portable *x*-ray examinations of the chest were made. There were patchy parenchymal processes in the lower lobe areas, the process on the right being more recent. This type of involvement is seen in infarctions. Instead of giving daily enemas, we thought it advisable to use glycerin suppositories. This procedure was carried on for about seven days, and the patient began having normal movements. On April 24 the patient was up in a chair. There was free expectoration from the chest. On the 26th, chest plates were again taken, and a wedge-shaped area of increased density was noted in the middle lobe on the right side, either an infarct or abscess. There was free expectoration with cough. The patient continued to improve.

On April 28, he sat up in chair; on May 6, the patient was beginning to walk, with very little discharge from the cecostomy.

May 30, the cecum practically healed.

We wish to emphasize the following practical points in the treatment of these cases.

1. The two-stage operation in cases with obstruction.

2. The administration of large quantities of normal or hypertonic saline solution and glucose, subcutaneously and intravenously.

3. The use of the nasal Levine tube for gastric drainage and the neutralization of toxins with 2 per cent saline solution.

4. The administration of an immunizing dose of gas bacillus antitoxin followed by daily intramuscular injections of sterile milk, in cases with peritonitis.

INTUSSUSCEPTION OF THE APPENDIX

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TO find any new pathological condition is rare, to say the least, at the present time. Most of us are always looking for it, and it is an agreeable surprise to find something new or unusual.

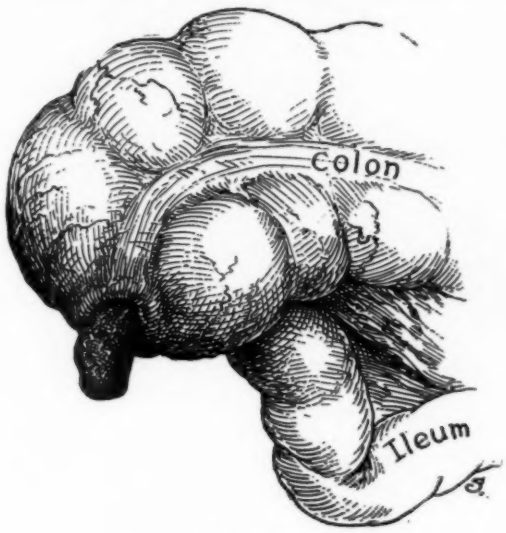

FIG. 1.

A case similar to the one I am about to report has never been published in medical literature, as far as I have been able to find. It is a case of intussusception of the appendix, without any involvement of the intestine.

F. T., female child, two and one-half years of age, case number 17941, in the Northern Westchester Hospital, Mount Kisco, N. Y., parents Italian, born in the United States.

Family history: Nothing of importance.

Past history: Weight at birth, 7½ pounds, normal delivery. The first six months she did not do well, at the end of that time only weighing 5½ pounds. Mother thought it was due to extensive rash all over the body (ezcema) and difficult feeding. When one year old, she was apparently up to normal, both mentally and physically, bowels always regular, although inclined to have a rather hard-formed stool. She was normal in weight and doing well, with no trouble with her feeding.

Present trouble began May 2, 1931. She got up that morning apparently as well as ever, ate her usual breakfast, bowels moving freely. At 11 A. M., while playing around, she began to

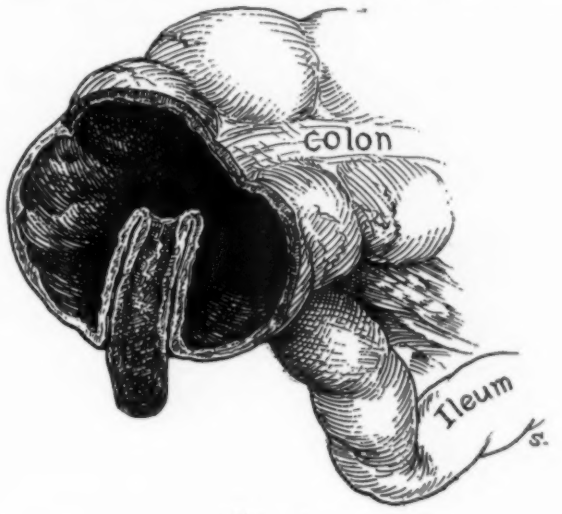

FIG. 2.

have irregular cramplike pains in her abdomen, those referred to were in the umbilical region. At first these pains were not very severe, but during the late afternoon they became much worse, coming on at regular intervals of about one-half hour, lasting only a few minutes. Between the pains she was apparently as well as ever, playing about. The paroxysms only lasted a few minutes, but by night they became so severe that she would cry out and press both hands against her abdomen, during the paroxysm, bending her body forward at almost a right angle. There was no apparent straining, as if her bowels wanted to move. When lying down during these attacks, she would draw her legs up, pressing them against her abdomen. During the night she slept very well, except that she was awakened several times by the attacks. After they passed off, she would fall asleep.

I saw her for the first time the morning of May 3 in my office, and made a tentative diagnosis of intussusception and advised that she be admitted to the hospital for observation. She walked into the hospital and began to play about in the waiting room. At that time I happened to go through, and in a few minutes

she had a paroxysm which was typical of the cases of intussusception that I have seen except not as severe. On admission her temperature was 99.6°F., rectal; pulse, 100. The urine showed trace of acetone and a few clumps of pus. Blood count: leucocytes 8300, polymorphonuclears 57 per cent. During the attack she had no vomiting, but her mother said she gagged a few times and apparently had some nausea. Physical examination showed a well-nourished female child, mentally very bright and alert for her age, tonsils very large and cryptic, slightly congested. The cervical nodes were slightly enlarged. A few coarse râles were heard throughout both lungs. The heart showed no pathology. The abdomen was slightly rigid in general, a little more so on the right side. There was some tenderness on deep pressure all over, more marked at the right lower quadrant. With gentle pressure, the fingers could be pressed slowly into the abdomen without giving her any pain. Rectal examination was negative. On admission she was given an enema, with good results. No blood or mucus was seen. She was not operated on at once on account of: (1) bronchitis, (2) abdominal symptoms did not appear urgent, (3) normal blood count. After the bowels moved she seemed greatly relieved and slept most of the afternoon and all of the following night. On the morning of May 4, she developed quite a severe coryza. Temperature 99°F., pulse 120, respirations 24. She was given an enema, followed by good results. During the day she had a few paroxysms, but not so severe as on the day of admission. The night of May 4 and 5, she slept practically all night, but had several paroxysms, typical of the previous ones, but not quite so severe. On the morning of May 5, rectal temperature had not been above 99.6°F., highest pulse 112. An enema this morning, followed by irrigation, showed some mucus but no blood. This was the most comfortable day since admission to the hospital. There was no vomiting; she took fluids freely. The nights of May 5 and 6, she slept most of the night, but had a few attacks which did not appear very severe. The morning of May 6, temperature was 99°F., pulse 100, at 8 A.M. An enema was given with good results: yellow liquid stool, foul odor, large amount of flatus, no blood or mucus. Abdominal examination this morning showed a marked rigidity of the right rectus muscle, especially the lower half. Pain was referred to the right lower quadrant. The right lower quadrant showed marked tenderness, and she would cry out with pain when this region was palpated. The diagnosis of intussusception was changed to acute appendicitis and operation advised.

Operation, morning of May 6: Preoperative diagnosis: (1) acute appendix, (2) intussusception. Anesthesia: ethyl chloride and ether. The abdomen was painted with iodine, the possibility of an intussusception being borne in mind. The midline incision was made below the umbilicus. There was an increase in the amount of fluid in the abdomen. Much to our surprise, an intussusception of the appendix into the head of the cecum had taken place. Only about 2 cm. of the tip of the appendix was sticking out. This was much enlarged and edematous. There was no evidence of beginning gangrene. There was some edema of the head of the cecum. More than two-thirds of the appendix had telescoped into the head of the cecum. The intussusception was reduced with difficulty, by squeezing on the cecum (the appendix could be felt easily through the walls of the cecum) and slight traction on the tip. During this procedure the peritoneal coat of the appendix was ruptured in several places, but the lumen was not opened. The mesoappendix was lacking, the blood vessel lying against the appendix. The lack of a mesoappendix may account for the intussusception.

In all cases of intussusception that I have operated upon, the mesentery has been very thin. The appendix after a reduction was ligated about 1 cm. from the head of the cecum, with No. 1 plain catgut; was then amputated with a carbolized knife and the stump inverted into the head of the cecum through a purse string suture of chromic catgut No. 0, this being reinforced by a number of Lembert sutures. The abdomen was closed in layers without drainage.

The patient made an uneventful recovery, except that her temperature the day following operation was 101°F. The second day postoperative, the temperature was normal. On account of the coryza and bronchitis, we anticipated some trouble. One year from operation, the child has good firm union of the wound and apparently is in the best of health.

Pathological report: Gross: The specimen consists of an appendix measuring 6 cm. in length. The serosa appears congested and covered with fibrinous exudate. The wall is greatly thickened and somewhat edematous. The lumen contains a fecolith and appears to contain necrotic material in several areas. Microscopic: an early stage of gangrenous appendicitis.

Diagnosis: Appendicitis, gangrenous.

TORSION OF THE OMENTUM SIMULATING APPENDICITIS

REPORT OF A CASE

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A MAN of sixty, who had previously enjoyed good health, was admitted to the hospital complaining of severe abdominal pain of twelve hours' duration. There was no nausea or constipation; temperature 99°F., pulse 80, W.B.C., 12,000, polymorphonuclears, 80 per cent. On examination the abdomen was slightly distended and generally tender, especially so in the right lower quadrant. The lower right rectus was very rigid. Direct hernias on both sides were found but these did not appear to be related to the acute condition.

Under spinal anesthesia a right rectus incision was made over the tender area. When the abdomen was opened a small amount of dark blood oozed out of the incision and a dark purplish mass was found in the right iliac fossa. On lifting this out of the wound it was noted that it was attached to the left side of the pelvis by a small but very tough band of tissue. As soon as this was severed the mass was readily delivered and found to consist of the entire great omentum and at the attachment below the pylorus the root was twisted upon itself six times, cutting off the blood supply completely. The pedicle was divided between two ligatures and the whole omentum removed. Exploration of the abdomen revealed no other pathological condition. There was about one pint of dark blood, mostly in the right side of the pelvis.

The specimen consisted of the entire large omentum with thrombosed and ruptured vessels and only isolated patches of living fat tissue, weight 900 gm.

The wound was repaired without drainage and the patient made an uneventful recovery.

FIG. 1. Gross specimen, showing lower half black and necrotic; living patch of tissue above middle line. Arrow points to large thrombosed and ruptured vein. (¼ natural size.)

It is stated in textbooks that torsion of the omentum is a rare disease. In 1931 there were twenty references in the Cumulative Index to this condition.

In our patient the omentum had become attached at its lower extremity to the pelvic peritoneum and then had turned from left to right on its long axis and it is likely that the last turn shut off the blood supply.

Bulman[1] reported a somewhat similar case in 1924. This was a patient, aged forty-four, who had been ill three days with pain in the right iliac fossa. This patient had an ovarian cyst on the left side and the omentum was attached but

only part of the blood supply was shut off.

Another instance of torsion of the omentum was reported by Schwank.[2] This was in a secundipara, aged twenty-five, in the sixth month of pregnancy. It was noted here also that there had been no nausea or constipation. According to Most, quoted by Schwank, 146 cases of torsion of the omentum had been recorded up to 1929 but a number have been reported since and it is probable that instances of simple torsion, unaccompanied by other lesions, are rare, but partial torsion, along with other pathological conditions, is relatively common and usually described in textbooks with lesions of neighboring organs.

Smyth[3] writes that the great majority of cases of torsion of the omentum occur in association with right-sided hernia and quotes Cowell's classification. If the condition is classified as simple torsion, not associated with any other lesion, and other types, the matter becomes much clearer. There can be no doubt that while rare, simple torsion is a definite clinical condition, and deserves a description in text books.

In 1928 Susman[4] reported a case of torsion of the omentum in a male, aged fifty-nine, similar to ours but no mention is made of distal attachment of the omentum.

MacAuley[5] reported 2 cases in 1928 and said thay were the only cases he had seen.

Coen[6] in 1928 reported a case in a male, seven years old, associated with appendicitis and he notes that the distal end was entirely free. In such instances the mechanism of torsion is obscure; given the known mobility of the omentum, one would suppose that it could right itself unless attached.

Torsion of appendices epiploicae is a closely related condition, with essentially the same mechanism and clinical course, and such a case was reported by Johansson[7] in 1926.

As to the diagnosis of this disease it would be a rare event for such a condition to be recognized before operation but fortunately the clinical course parallels acute appendicitis closely and most patients have been promptly operated upon under that diagnosis.

Treatment is clear. In all instances reported resection was done and the indication is so plain that no surgeon would hesitate to practice this even if dealing with his first case.

In all instances the prognosis in case of early operation is good since removal of part or all of the great omentum does not entail any serious consequences.

In recent literature no case is reported of patients with this condition who were not operated upon. While at first sight one might suppose that, unless promptly relieved, fatal peritonitis would result, this is by no means inescapable, in view of the extraordinary tolerance of the abdominal organs.

This problem may be summarized by saying that torsion of the great omentum is rare but occurs as a definite clinical entity and that the diagnosis before operation is next to impossible. The treatment is resection, without drainage, and the prognosis is good. In any instance of acute appendicitis, when the symptoms are not classical, one may do well to keep in mind the possibility of this condition.

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TOTAL SUPPRESSION OF ACID GASTRIC SECRETION AND HUNGER CONTRACTIONS BY MEANS OF JEJUNOSTOMY

EXPERIMENTAL AND CLINICAL STUDY*

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WHILE experimenting with gastric-pouch dogs that were being fed by means of a jejunostomy, Professor A. C. Ivy and his associates, P. H. Hollinger and E. H. Kelley, made some interesting observations on gastric secretion. Before feeding through the jejunostomy is commenced the mucous membrane of the gastric pouch is of a livid, red color and secretes acid juice freely. Shortly after the jejunal feeding is started the mucosa turns a pale pink and becomes dry because it has ceased secreting acid. Ivy found that the latent period during which no acid was secreted following the jejunal feeding varied considerably, depending upon the nature of the feeding and the distance of the jejunostomy from the duodenal juncture. He found that by introducing undigested food, such as is contained in the Ivy mixture[1] the latent phase was considerably longer than when partially digested food was used. The cessation of gastric secretion from the gastric pouch which occurred for two to four hours following a jejunal feeding of one hours' duration is due to the *elimination of the intestinal phase of gastric secretion* which probably results from inhibitory reflexes elicited by sensory stimulation of the intestine. The intestinal phase of acid secretion is normally responsible for about 400 c.c. of gastric secretion in twenty-four hours in the dog.

By continuous jejunal feedings over a period of nine hours of a bland food as is contained in the Ivy mixture, Hollinger and Kelley were able to show that only 21 c.c. of gastric juice were secreted from the gastric pouch during this period of time. This small amount of acid undoubtedly represents the basal secretion. By repeating the experiment described, but by adding atropine *no acid was formed during this period of nine hours.*

It is also interesting to note that Hollinger and Kelley were also able to demonstrate by means of a balloon introduced into the stomach through the pouch, that during a nine-hour period of continuous jejunal feedings, there were no hunger contractions demonstrable on the kymograph.

It occurred to us that if one could eliminate the important intestinal phase of gastric secretion, as well as the gastric and cephalic phases of gastric secretion and the secretion of gastric juice that is due to a hormone from the pyloric end of the stomach, *one could cause the total suppression of acid secretion from the stomach* and that this total suppression as well as the physiological rest that results from jejunal feedings, might be an important factor in causing the better healing of stubborn duodenal ulcer cases. The preliminary report of this treatment of certain duodenal ulcers by means of *continuous jejunal feedings* has already been described.[2] The gastric phase of gastric secretion is of course eliminated by withholding everything by mouth and the basal secretion due to the hormone, gastrin, can be readily checked at least in the dog and possibly in man by atropine. Hollinger and Kelley were further able to show that the *cephalic*

[1] Scott and Ivy, A. C. *Ann. Surg.*, 93: 1197, June, 1931.

[2] Mensing, E. H. Treatment of certain cases of duodenal ulcer by jejunostomy. AM. J. SURG., 15: 105, 1932.

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or psychic phase is inhibited during jejunal feedings. A hamburger steak placed at the nose of the dog while being fed per jejunum did not cause the secretion of any "appetite" juice from the pouch.

It occurred furthermore that the observance of the principles of eliminating the three phases of acid secretion as well as hunger contractions by means of continuous jejunal feedings of a bland, undigested food might be of great value in the treatment of certain cases of gastric fistula, and fortunately such a case came under our observation only recently and we desire to report the findings briefly.

H. C. McI., aged thirty-seven, was operated upon in another institution March 29, 1932 by another surgeon for an acute perforating ulcer of the stomach. The usual closure was apparently done, but for some reason or other the patient developed a gastric fistula. No attempt was made to close it, instead a tube was inserted into the fistula, and suction was applied. The patient's condition steadily grew worse. He became dehydrated and was slowly starving and his abdominal wall was commencing to become markedly irritated from the discharging gastric juice. In order to avoid death from starvation, an enterostomy was performed, apparently in the ileum, and feedings were commenced through it. The surgeon was at a loss to understand why the patient continued to get worse instead of better. About one month from the day of the perforation, the patient was sent to the Veterans' Hospital to die. This transfer was done at the relatives' request, because they wanted the "patient's body" to be transported to Iowa at government expense. Shortly after admission to the Veterans' Hospital the patient was seen by Dr. Mensing. A more miserable, unfortunate specimen of humanity could hardly be visualized. He had lost tremendously in weight, he was markedly dehydrated, semiconscious and suffering from the collection of mucopus in his respiratory passages, which suggested a "death rattle." The alkalosis apparently was extreme. The two laparotomy wounds were widely digested and the skin of the entire abdomen had suffered from the acid corrosion. He was markedly cyanotic and could be only slightly aroused from a deep stupor. Transfusion with 500 c.c. of blood and 3000 c.c. of 10 per cent glucose in normal saline solution, and 20 c.c. of 20 per cent hypertonic saline solution were carried out intravenously. The blood-volume appeared to improve a little and the patient was taken to the operating room, where under abdominal block anesthesia Dr. Mensing did a hurried closure of a large gastric fistula by means of three interrupted chromic gut stitches and a still more hurried Witzel jejunostomy. During the operation, which took only fifteen minutes, artificial respiration had to be resorted to frequently. The wound was closed with nothing but interrupted silkworm gut stitches. The patient was placed in an oxygen tent, intravenous saline solution and glucose were continued and jejunal feedings of a diluted Ivy mixture commenced. Because some of the partially digested feedings escaped through the old ileostomy, a pump was applied to the latter, and whatever feedings escaped from the ileostomy were immediately re-introduced into the jejunal feeding pump. The patient to our surprise made an uneventful recovery. The ileostomy closed without requiring surgical intervention and at no time following a very hurried, incomplete closure of a large gastric fistula did any gastric juice escape, due no doubt to the fact that the intestinal phase of gastric secretion had been eliminated by the continuous jejunal feedings of undigested food and because the gastric phase of gastric secretion had been eliminated by withholding everything by mouth, and because the basal secretion most probably had been checked by giving atropine. The psychic phase of gastric secretion had apparently been inhibited by the continuous jejunal feedings and the motor activities of the stomach were for all practical purposes completely inhibited.

During the convalescence the patient developed frequent chills with a temperature of 103°F. and over and we were at a loss to understand what caused these symptoms. The laboratory reported finding the aestivo-autumnal type of malarial organisms in the blood. Then to complicate matters the patient developed, about four weeks after his operation, an acute intestinal obstruction. He was operated upon immediately and we found a very dense, firm band completely constricting the lower ileum in the region of the ileostomy that had been performed some months previously by another surgeon. When this band was released we found that the ileum had been

almost completely cut in two. The perforation was closed with interrupted chromic stitches and to our surprise the gut immediately became active, and while we were sewing up the abdomen the patient had a huge involuntary bowel movement (spinal anesthesia was used). His convalescence was uneventful.

SUMMARY

In dogs the gastric, intestinal and cephalic phases of gastric secretion, as well as hunger contractions, can be eliminated by continuous jejunal feedings of bland, undigested food, when it is introduced at least 9 inches from the duodenojejunal juncture. The basal gastric secretion may be eliminated by administering atropine.

These findings, the result of experiments upon gastric-pouch dogs who had a properly performed jejunostomy, and who were fed the so-called Ivy mixture of undigested food continuously for nine hours, suggest that the same results can be obtained in the human being. They suggest, furthermore, possibilities in the treatment of certain gastric and high duodenal fistulas, which are difficult or impossible to heal by other surgical procedures. They suggest the further possibility, that an incompletely closed gastric fistula such as that described can be kept from secreting corrosive acid juice by observation of the afore-mentioned physiological principles.

INCIDENCE OF PEPTIC ULCER AND ITS COMPLICATIONS*

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FROM discussions of the etiology, diagnosis and treatment of gastric and duodenal ulcer, one is led to believe that the etiologic factors are definitely understood, the diagnosis accurately determined by roentgenologic study, and the treatment most satisfactory in the hands of a competent internist, but very unsatisfactory in the hands of a surgeon. In spite of the optimistic reports on this serious disease, we have encountered an increase in the total number of cases of ulcer admitted to Bellevue Hospital during the past twenty-one years; an increase is also found in the relative percentage of ulcer cases to total admissions which is so definite as to cause serious concern. Table I gives the total admissions by year with the number and percentage of ulcer cases. This increase would seem to indicate that the etiology is little understood or prophylactic measures would effect a decrease in the incidence of the disease. Bevan[3] states the etiology is represented by X, Y, Z, "X" representing gastric juice containing pepsin and free hydrochloric acid, "Y" local trauma due either to mechanical or bacterial agents, and "Z" lowered resistance of the individual. If the etiology of peptic ulcer was as represented by Bevan we could take steps to diminish the frequency of the disease. One might say that the increase is more apparent than real because the patient is more thoroughly studied now than he was twenty-one years ago; but these statistics have been taken from the annual report of a charity hospital and the type of patient has not changed during this period. The hospital has four divisions, three of which are connected with medical schools; it may fairly be assumed that the patients have been carefully studied. Moreover, the barium meal for gastrointestinal study was introduced in Bellevue Hospital by Hirsch[7] in 1910.

If one maintains that the increase in peptic ulcer has been relative and not actual it is difficult to explain why the number of acute perforations and gross hemorrhages has shown such a marked increase during the past few years. From Table II, it can be seen that there has been a marked increase in acute perforated ulcers since 1923. It is hardly conceivable that this is due entirely to improved diagnostic methods, because an acute perforation usually presents classical symptoms. Even in the atypical cases, if the diagnosis was not made before death, an autopsy would establish a definite diagnosis. The statement is made that ulcers under medical treatment will not perforate, but in the Gastro-Enterological Clinic of the Fourth Medical and Surgical Divisions of Bellevue Hospital, during the past four years, we have had 8 cases that have perforated while the patient was being treated medically.

In the hemorrhage cases there has been a marked increase during the past three years. I include only those cases in which there were one or more gross hemorrhages, severe enough to keep the patient from work and confine him to the hospital. Table III gives the total number of cases and the year in which they occurred; it is very disconcerting to see the increase since 1928. Some clinicians hold that bleeding ulcers will not prove fatal but our cases do not bear out this impression. Eight fatalities from gastric hemorrhage have occurred on the Fourth Division. In each instance the patient was receiving supportive measures, but an operation could not have been done because of the extreme condition of the patient, even if a surgeon

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had so desired. I wish to call attention to the fact that in four of these the history of previous gastric complaints was either

Table 1

TOTAL NUMBER OF ADMISSIONS WITH PERCENTAGE OF ULCER CASES

Year	Gastric	Deaths	Duodenal	Deaths	Total Ulcers	Total Admissions	Percentage of Cases with Ulcers
1910	29	4	...	..	33	36,330	.09
1911	48	6	...	..	54	37,578	.14
1912	39	8	...	..	47	40,296	.11
1913	56	10	...	..	66	41,248	.16
1914	55	8	...	..	53	43,297	.12
1915	73	7	23	4	107	44,485	.24
1916	108	16	50	4	178	45,422	.39
1917	88	17	62	7	174	45,470	.38
1918	89	11	55	4	159	42,563	.37
1919	71	6	34	1	112	38,850	.30
1920	61	10	43	3	115	38,945	.30
1921	59	15	56	5	135	43,597	.31
1922	79	13	81	7	180	45,671	.40
1923	75	13	101	10	199	45,258	.44
1924	137	9	148	5	299	49,344	.61
1925	119	16	164	10	309	49,511	.62
1926	115	16	138	8	277	48,293	.57
1927	88	20	151	11	270	49,986	.54
1928	143	21	198	11	373	52,336	.71
1929	114	21	158	17	310	52,643	.59
1930	123	21	212	10	335	57,292	.59
1931	169	26	253	18	422	63,837	.66

brief or wanting; the first symptom was a profuse hemorrhage. The fact that in four of the fatal cases fusion was not performed would indicate the danger of not transfusing in spite of the fact that some gastroenterologists are teaching that transfusion should not be done in cases of bleeding ulcer. In three of these cases transfusion was not done because death followed so soon after the onset of the hemorrhage; the fourth case occurred twenty years ago before transfusion had become a hospital routine. The point is not that transfusion would have saved any of these but that in cases of severe (but not dramatic) hemorrhage transfusion is not dangerous.

Perforations have occurred about twice as frequently as hemorrhage and it is an interesting clinical observation that hemorrhage and perforation are never associated in the same case. This seems to be due to two different underlying pathologic processes: in the acute perforations apparently embolism or thrombosis of the vessels causes acute necrosis of the duodenal or gastric wall. Clinical experience bears out the fact that in a high percentage of cases of acute perforation there is no history of ulcer; in a report of 105 cases[5] two years ago it was stated that in 19 cases there was a negative history and in 24 others the patient was not questioned in regard to previous symptoms of ulcer. In the bleeding ulcers the history is different; it is not uncommon for a patient to have several hemorrhages at intervals of twenty-four to forty-eight hours, while supportive treatment is being administered. The bleeding ulcer would seem to represent an inflammatory process with erosion of the vessels in the submucosa.

The ever-constant question as to whether ulcers are the forerunner of carcinoma is as far from settled as when MacCarty[8] published his work in 1910. Pathologists do not agree among themselves on this important question, and those of us who

are clinicians are in a difficult position when it comes to advising a patient how to choose between medical and radical surgical treatment. From the clinical observations in our clinic, the question of carcinoma arising in an ulcer of the stomach or duodenum is more theoretical than practical. However, there are certain facts that must be considered and one is why a duodenal ulcer does not become carcinomatous when duodenal ulcer is about eight times as common as gastric ulcer. It is known that primary carcinoma of the duodenum occasionally occurs and is more frequently encountered than carcinoma of the jejunum or ileum. That being the case, one would naturally expect to find duodenal ulcers taking on carcinomatous changes, occasionally, but a careful review of the literature by me[6] on this subject failed to reveal a definitely proved case. The difference in the mucous membrane of the duodenum does not offer a logical explanation, because the transition at the pylorus is not abrupt but gradual. Clinically it is rare to see carcinoma developing in a patient with a gastric ulcer; and by that I mean an ulcer that was diagnosed by roentgenologic study, and carcinoma demonstrated at the same site as the original ulcer, at some later date. Of course, an ulcer in one part of the stomach, or duodenum, may be followed by a carcinoma at another site, with no relation between the two lesions. Cases have been reported[5] to prove that this does occur. In 1930 Balfour[2] reported 100 cases of gastric ulcer in which the patients had been followed for ten years or more after gastroenterostomy without excision of the ulcer. I quote in part from this paper:

> One hundred cases were studied in which gastroenterostomy alone was done for gastric ulcer, since the surgeon considered it unwise to attempt removal of the lesion. It should be said that the surgical staff of the clinic has always subscribed and still subscribes to the belief and practice that removal of the lesion, if it is reasonably possible, should be a part of the surgical procedure. . . . This being true, I have been surprised to find so many patients with gastric ulcer who have been completely relieved of symptoms by gastroenterostomy

TABLE II

SHOWING YEAR OF PERFORATION

Year	Died	Improved	Total
1911	0	1	1
1912	2	0	2
1913	1	2	3
1914	0	4	4
1915	2	1	3
1916	0	2	2
1917	3	3	6
1918	1	4	5
1919	1	3	4
1920	0	3	3
1921	1	2	3
1922	1	4	5
1923	3	6	9
1924	1	7	8
1925	0	8	8
1926	3	5	8
1927	0	9	9
1928	0	9	9
1929	1	12	13
1930	2	9	11
1931	5	14	19
	27	108	135

TABLE III

YEAR IN WHICH HEMORRHAGE OCCURRED

Year	Number
1911	4
1912	1
1913	2
1914	1
1915	1
1916	1
1917	0
1918	1
1919	0
1920	0
1921	1
1922	0
1923	1
1924	3
1925	2
1926	2
1927	3
1928	10
1929	13
1930	11
1931	11
	68

alone. I am convinced that gastroenterostomy alone is the operation of choice in those cases in which the size of the lesion, or its situation, or the age or condition of the patient makes the removal of the lesion, by whatever method, a difficult or hazardous procedure. I would emphasize the point, then, that the group of cases studied represented lesions which were relatively immovable. . . . The possibility of carcinoma developing in the unremoved lesion is most important; in six cases such a sequel was established or suspected. The fact that all of these cases were listed as gastric ulcer at the time of operation should be conclusive evidence that there is a relationship between gastric ulcer and gastric carcinoma. The desirability, therefore, of removing a gastric lesion is clear, but it should not be removed if removal is a greater risk than the liability of the development of subsequent serious complications.

Balfour's findings render the observations of MacCarty[8] (that 68 per cent of ulcers show carcinoma) chiefly of histopathologic significance and of little clinical importance. Alvarez[1] in 1931, in studying the histories in 41 physicians with cancer of the stomach, has laid great stress on gastric ulcer as the forerunner of gastric carcinoma, but in 20 of the 41 cases there was a short history. To quote in part from his paper:

One of the greatest difficulties in the way of ever curing many cases of cancer of the stomach is the thesis still being expounded by some gastro-enterologists, that it is not dangerous to treat medically patients with gastric ulcer. For years it was a puzzle to me how any physician of large experiences could hold such a view, but of late I think I have found the source of difficulties. The trouble is that these men all seem to take it for granted that the diagnosis of ulcer can be made with ease and perfect accuracy. Having inherited the idea that ulcers are craters and cancers are tumors, it does not occur to them that a crater may be part of a cancer; they are not prepared for the idea, and as a result when they receive the roentgenologist's report of "ulcer" they unconsciously read into it the adjective "benign."

In his comments he states:

The patient with a small ulcer niche in the stomach who has had attacks of hunger pain intermittently for ten years or more doubtless has had a benign ulcer; if recently there has been no marked change in the symptoms, the chances are large that it will stay benign.

From the reading of Alvarez's paper I am persuaded that the difficulty is in the differential diagnosis between cancer and ulcer, and not in the carcinomatous transformation of benign ulcers; but if a competent roentgenologist studies these cases and repeats his examination in the borderline cases after the Sippy regime has been instituted for ten to fourteen days, he will be able to make an accurate diagnosis in most instances. Buckstein[4] states that he has very rarely been able to demonstrate a carcinoma developing in an ulcer that he has diagnosed as benign in over 20,000 gastrointestinal examinations. The cases reported by Balfour reveal that we need not get unduly alarmed over carcinomatous transformation of gastric ulcers.

In 332 of the 460 cases of ulcer that are under observation, treatment has been conservative whether the lesion has been gastric or duodenal, and the only indication recognized for operation was persistent pain that could not be relieved by any method of medical treatment; as yet, we have not observed a single case in which carcinomatous changes have been found clinically, although we have referred only 25 of the 332 cases for surgical treatment, and they were all duodenal ulcers that were operated upon. These 332 cases included 280 duodenal, 31 gastric, 14 pyloric and 7 double ulcers (ulcers in both stomach and duodenum).

From our observations there is more reason to be concerned over the increase in the frequency of peptic ulcer and the complications of perforation and hemorrhage than over carcinomatous tranformation. We have had 15 cases of gastric carcinoma, but in all of these the onset was insidious and gave no support for a diag-

nosis of previous ulcer. If one is inclined to lean to the infectious theory of ulcer it is difficult to explain the increase in perforation and hemorrhage, because, as a result of the general education of the layman, more attention has been given to infected teeth, diseased tonsils and sinus infections during the past twenty years. If one wishes to condemn medical treatment he might try to attribute the perforations and hemorrhages to delay in instituting surgical treatment; but that, of course, does not explain the increase in the total number of cases of ulcer. Every case of ulcer registered in the clinic is considered a medical problem and medical care is instituted and continued in one form or the other, unless pain forces recourse to surgery. The different types of medical treatment employed include ambulatory Sippy diet, vaccine of specific or nonspecific type, vitamins and gastric mucin. If the patient is not progressing satisfactorily under one method of treatment, he is given the benefit of all the different types of medical treatment before finally being referred for surgical treatment.

The internists in the clinic, Doctors Hartung, Fuller and Trubek, will evaluate their results at a later date, but, to keep under close observation the 460 cases under treatment, they have made a sum total of 6007 visits during the past four years. We are thus having a fair opportunity to evaluate the results of the different methods of treatment, and the impression one gathers from the study of this group of cases in that more attention and study should be given to the etiology of the disease and less enthusiasm shown concerning the claims of any method of treatment.

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A NEW METHOD OF BLOCK ANESTHESIA

SEGMENTAL PERIDURAL SPINAL ANESTHESIA*

PROF. A. M. DOGLIOTTI

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THE method of anesthesia which will now be described and which was worked out by me has been in use for three years with increasing success. It is intended to produce, as a result of a *single injection which does not involve the subarachnoid space*, a complete, sufficiently long and deep anesthesia in any part of the body to enable any surgical intervention to be carried out.

By this method the advantages of local anesthesia with its freedom from risk are combined with those of subarachnoid spinal anesthesia with its powerful and satisfactory action. Briefly described it is a procedure which makes it possible to obtain in the upper parts of the body just as excellent results as may be had in the region of the sacrococcygeal plexus after sacral extradural anesthesia has been performed.

FUNDAMENTAL PRINCIPLE OF PERIDURAL ANESTHESIA

The physiological basis of the method is readily understood. We learned from anatomy books and our own investigations on the dead body the topography of the connective and fatty tissues surrounding the dural sack in the spinal canal. In this connection I would like to draw attention to several very complete investigations into these matters which have been made by persons other than the writers of anatomical textbooks. I would like especially to mention the work of Sterzi who published in 1905 his observations on the peridural tissues of the vertebrate animals. This author dealt with his subject most exhaustively. When I began my own investigations into this subject I made sections through the spinal column of frozen bodies; in addition, by the injection of various suitable dye substances I was able to obtain a very accurate idea of the anatomical and physiological principles governing the spread of injected fluids in the peridural spaces.

In referring briefly to the most important facts concerning the anatomy of these spaces I would like to reiterate that the dural sack lies in the cavity of the spinal canal surrounded by a more or less well-developed layer of connective tissue which exhibits variations from one person to another. This contains a considerable quantity of fat and numerous vessels. This loose and lightly attached tissue extends round the dura and surrounds the skin-like sheaths which originate in the dura and cover the roots of the spinal nerves up to the spaces between the vertebrae. This tissue continues uninterruptedly through the intervertebral foramina to join the paravertebral connective and fatty tissue outside the spine. It will thus be evident that a direct connection exists between the peridural space and the connective tissue immediately adjacent and external to the vertebrae. In some places this connection is a narrow one since the intervertebral foramina contain, in addition to the nerves and the spinal ganglia, a number of bands of fibrous tissue. Despite this local narrowing the foramina still permit some of a fluid which has been injected under pressure into the peridural space to pass through them.

This state of affairs is particularly favourable to our method for if a solution be injected into the peridural space it

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will first of all spread round the dura within the spinal canal. From this part it spreads slowly along the meningeal sheaths

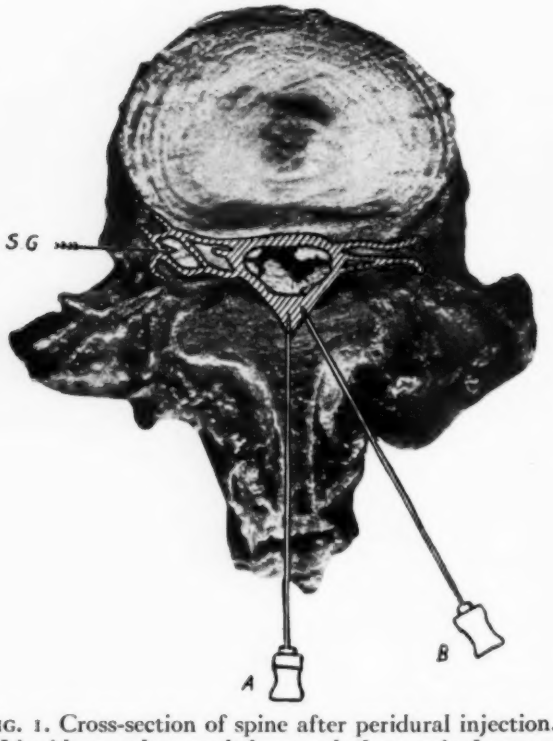

Fig. 1. Cross-section of spine after peridural injection. Liquid spread around dura and along spinal nerves and ganglia (s.g.). A. Needle in place (point is in peridural space) by midline route. B. Lateral route.

which surround the nerves and spinal ganglia and then leaves the canal by way of the intervertebral foramina to enter the paravertebral tissues in which it diffuses further. (Fig. 1.) It thus happens that the anesthetic solution is in uninterrupted contact with the spinal nerves over a considerable distance and that it may finally even bathe the ganglia and the paravertebral chain of the sympathetic. If therefore the anesthetic solution is injected in sufficient quantity (50–60 c.c.) and under adequate pressure it will be quite easy to subject to the action of the injected fluid the spinal nerves throughout their length in the spinal canal, the intervertebral foramina and even externally. As has already been stated this method of infiltration may also be made to affect the rami communicantes in the paravertebral connective tissue while the ganglia and the sympathetic chain are often similarly involved. It is possible to see distinctly the diffusion through the foramina and along the nerves on *x*-ray plates after an injection of lipiodol in the peridural space. (Figs. 2–5.)

The circumstances are thus ideal for blocking all the spinal and sympathetic nerve tracts to all painful stimuli in any area which may be chosen. According to the height at which the injection is made and the amount of solution used, so will the extent of the anesthetised area vary. (Figs. 6 and 7.)

As a rule it is possible to obtain deep and complete anesthesia over from eight to ten spinal segments (Fig. 8-B-B) by the use of 60–80 c.c. of a 1 per cent solution of novocaine or stovaine with 20–25 drops of adrenalin.[1] This should be given in two injections, 20 c.c. to begin with and 30–40 c.c. after four to five minutes.

Above and below the full anesthetized area will be found zones of hypesthesia in which sensation varies in degree. These areas of diminished sensation gradually disappear as they are traced up and down respectively.

TECHNIQUE OF PERIDURAL ANESTHESIA

I do not propose to describe the stages by which this method of anesthesia developed nor is it necessary to mention the precautions which I at first took in order to avoid risk and complications and to verify the various steps in the technique. Today I am in a position to describe the whole procedure in a few simple rules which, if followed with care by any surgeon or anesthetist who is practised in lumbar punctures, will enable a fully satisfactory and perfectly safe anesthesia to be obtained.

INSTRUMENTS REQUIRED

A lumbar puncture needle of medium size will be needed and it must be one with

[1] Now I use 35–45 c.c. of a 1.5 per cent solution of novocaine in physiological saline or 2:1000 nupercaine solution with 20–25 drops of adrenalin.

a very short point; a 20 c.c. syringe; a fresh solution in physiclogical saline of 1.5 per cent novocaine or of 1–2 per 1000 nupercaine to which 2 c.c. of adrenalin per 100 c.c. of solution have been added. If desired any local anesthetic may be used instead of nupercaine or novocaine if made up in the usual strengths for local infiltration. It is important that the anesthetic should be dissolved in physiological saline solution and that 1 c.c. of adrenalin be added for every case.

Fig. 2. Roentgenogram immediately after injection of 6 cm. of lipiodol in peridural space.

POSITION OF THE PATIENT

The patient should assume the position usually adopted for spinal anesthesia. The puncture may therefore be made with the patient in the sitting position and leaning forward or alternatively lying on the side with the spine well flexed. For a long time I preferred the sitting position as it enables the patient to keep the spine in a more symmetrical line and to bend more easily in the dorsal and lumbar part. Today however I usually like the patient to be on his side with the back horizontal and acutely flexed with the knees drawn up and the head forward so that the chin rests on the chest (Fig. 9). The horizontal position is certainly not so easy for the operator but has the following advantages:

1. The patient lies more quietly and does not become so tired; this is a considerable advantage in our method in which several minutes' immobility are necessary.

2. Slight degrees of collapse which are sometimes seen after the injection are more easily avoided. These are sometimes due to psychical influences. The patient may be unusually sensitive or in poor general condition or he may be secondarily affected by the anesthetic. Injection should be made slowly.

It may happen that after the injection of about 20 c.c. of the solution, general symptoms due to too rapid absorption of the anesthetic appear (pallor, cold sweats, small pulse, malaise etc.). If, when this happens, the patient is in the sitting position the manifestations of bulbar and cerebral anemia will be naturally more marked so that the patient has to be put in the recumbent position. If the injection has not been completed and a change of position has to be made, there is some danger of the needle snapping as a result of the movement of the spinal column. If however the patient has been lying on the side from the first there will, to begin with, be less collapse due to mental stress and absorption of the drug and no change of position will be needed to cope with untoward symptoms. All that is needed is to incline the table so that the patient is slightly in the Trendelenburg position, to inject ephedrin or caffeine should they seem indicated and to wait a few minutes. As soon as the general symptoms have disappeared the injection of the solution may carefully be resumed.

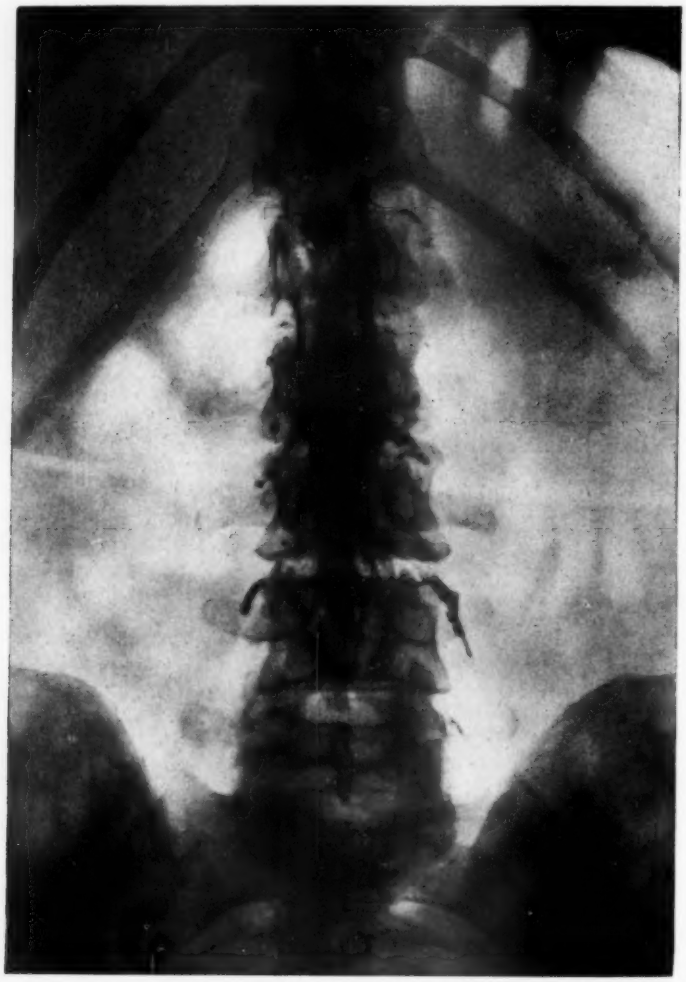

Fig. 3. Roentgenogram twenty minutes after injection of 6 cm. of lipiodol in peridural space.

I attach great importance to the position of the patient. It is necessary that he should lie on that side on which the deeper degree of anesthesia is desired. For example, if operation on the left kidney be intended then he should lie on the left side and if the appendix or the gall bladder are to be dealt with he should lie on the right. I have been able to show why this is necessary by making injections in the dead and the living, using solutions which were opaque to the *x*-rays. Substances which are injected into the spinal canal tend at first to diffuse symmetrically and uniformly but they are subsequently more and more affected by the laws of gravity. The solutions which are used diffuse more to the lower than to the higher lying parts of the canal.

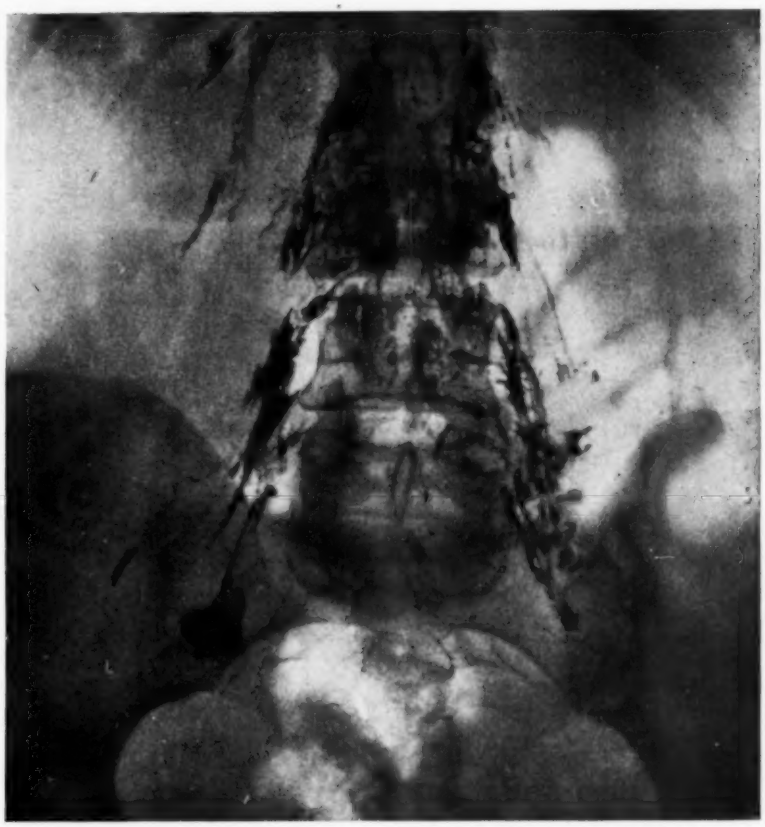

Fig. 4. Roentgenogram twenty-four hours after injection of 6 cm. of lipiodol in peridural space.

SITE OF INJECTION

The space between the vertebrae into which injection is to be made will be chosen approximately according to the level at which anesthesia is desired. A difference of two or three spaces up or down will not matter. We know that the injected fluid spreads up and down for a considerable distance so that it is unnecessary in a given operation to adhere rigidly to one fixed point for the injection. It will be enough if the following rules are followed:

1. *Anesthesia of the lower limbs, of the pelvis* and its organs, the groin and the pubic region: $L_3 - L_4$. To obtain a complete anesthesia to include the perineum and the organs of the true pelvis it is advisable at the same time to carry out a sacral epidural anesthesia.

2. *Anesthesia of the lower abdomen,* (operations below the umbilicus): from D_{12} to L_1 or L_2.

3. *Anesthesia of the upper abdomen,* really of the *whole abdomen* including the viscera of the right and left hypochondria and of the *region of the loins:* from $D_8 - D_{12}$ or L_1. If it should be found very difficult to make

the injection in the higher spaces it will be found possible to obtain a complete anesthesia of the abdomen by injecting at the Trendelenburg position the flow of the anesthetic towards the thorax and the neck will be facilitated.

FIG. 5. Roentgenogram six hours after injection of 12 cm. of iodipine in peridural space.

level in L_1 or L_2. It will be necessary however to use a larger quantity of solution (60–70 c.c.) and to inject more quickly so as to obtain a higher pressure in the spinal canal and force the solution to a higher level. By putting the patient slightly in the

FIG. 6. Roentgenogram of spinal column (human cadaver) after an injection of 10 cm. of lipiodol in peridural space.

4. *Anesthesia of the thorax and the upper limbs:* from about D_4 to D_{10}. When this is attempted the amount of the injected fluid must not exceed 40 c.c. for a larger quantity might spread to the cervical roots causing a too extensive anesthesia and an even more undesirable motor paralysis of the respiratory muscles. The diaphragm and the accessory respiratory muscles of the neck might likewise be affected so that artificial respiration would be needed to support the spontaneous actions of breathing.

5. *Anesthesia of the neck:* $C_4 - C_5$. At this level the injection of not more than 10–20

c.c. may be made and the greatest care and very slow injection are necessary.

DETAILS OF THE PUNCTURE

The needle may be put in either in the midline or a little to one side and at the level which has been chosen. Puncture in the midline is advisable as by this means it is most easy to avoid piercing the dural sac. This is due to the fact that the extradural fatty tissue is most abundant in the middle line. Lateral puncture has the advantage that it permits the use of the spine as a deep point of reference. At present I am in the habit of making the puncture in the midline. When this is chosen one pierces the ligamentum interspinosum for a certain distance. When the needle is then cautiously advanced still further, anyone who is acquainted with the procedure of lumbar puncture is easily able to state (in 9 out of 10 cases) when the point has just penetrated the posterior part of the ligamenta subflava and entered the peridural space. If, when this position has been reached, the needle is pushed no farther and one makes certain that no cerebrospinal fluid is escaping, one may without further delay inject the anesthetic solution into the peridural space in which it will immediately spread. This, however, is not the most certain method. In some cases it is not possible to decide exactly at what moment the needle pierces the ligamentum subflavum. In others, especially when the injection is being made in the region of the thoracic or lumbar parts of the spine or in certain individuals where the peridural tissue is very scanty and shrunken so that the dura lies rather close to the bone. When this is the case it is very easy to pierce the dura. It is true nevertheless that one may withdraw the needle without causing much damage and carry out the peridural injection as soon a the liquor has ceased to flow. In spite of these facts I consider it appropriate to make a routine use of the following very simple procedure which I now use with invariable success:

When the needle has penetrated the ligamentum interspinosum for a certain distance and before it has gone through the

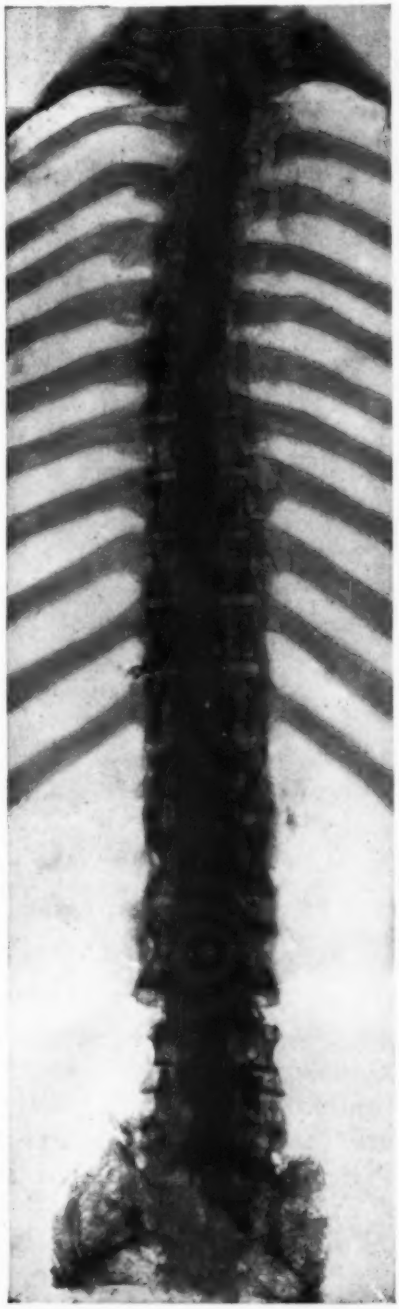

Fig. 7. Roentgenogram of spinal column (human cadaver) after injection of 20 cm. of lipiodol in peridural space.

ligamenta subflava into the spinal canal one removes the trocar and attaches a syringe filled with physiological saline. When an attempt is made to inject this fluid a *very great*

resistance is met with since the ligamentum interspinosum and the ligamenta subflava are so dense. If they can be injected at all it will be only after the employment of considerable force. *This resistance is most certain evidence that the needle is still in the posterior fibers of these tissues.* The following maneuvres are then carried out (Fig. 10):

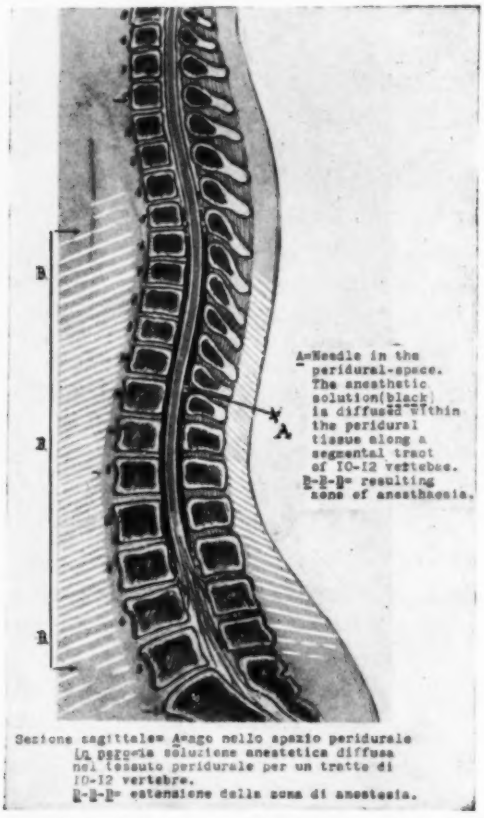
A=Needle in the peridural-space. The anesthetic solution(black) is diffused within the peridural tissue along a segmental tract of 10-12 vertebae. B-B-B= resulting zone of anesthesia.
Sezione sagittale= A=ago nello spazio peridurale in cui=la soluzione anestetica diffusa nel tessuto peridurale per un tratto di 10-12 vertebre.
B-B-B= estensione della zona di anestesia.

Fig. 8. Schematic drawing: Sagittal section of spinal column after a peridural injection. Anesthetic solution (black) spread round dura along a segmental tract of 10–12 vertebrae. B.B.B., resulting zone of anesthesia.

The syringe is held in one hand *the thumb of which* applies a continued and uniform pressure to the piston. The other hand *slowly advances the needle into the tissues* and when it has traversed a few millimetres the hand which is holding it will *suddenly note a diminution in the resistance to its passage which has previously been due to the tissues of the ligamenta subflava. At the same instant the injection fluid enters freely.* This is certain, practical and unequivocal evidence that the point of the needle has pierced the ligamenta subflava and is in the peridural space *which offers no resistance to the flow of the injected fluid. As soon as this position has been recognized the needle should be left in the position which it now occupies for its point is in the peridural space;* any attempt to advance it farther would entail the risk of penetrating the dura. Furthermore there is no point in pushing it any farther since the loose and easily displaced peridural tissues are easily infiltrated. The simple procedure which I have described has consequently a double purpose:

1. *It enables the anesthetist to gauge the exact moment in which the needle traverses the ligamenta subflava and enters the peridural space.*

2. *By its use the dura may be pushed farther away from the walls of the spinal canal;* this may be done even in cases in which there is but a sparse peridural tissue and the dura is in close apposition to the ligamenta subflava.

It may once again be emphasized that in the midline, between the dura and the ligament, there is always a distance of a few millimeters. In this part the peridural space is always wider and is triangular in section; the apex of the triangle is formed by the fusion of the laminae to form the spinous process (Fig. 1).

Injection of the Anesthetic Solution. As soon then as one has made sure that the needle is in the peridural space one aspirates gently with the empty syringe in order to make certain that no blood or cerebrospinal fluid flows out. (The first can only occur in the exceptional cases in which a vein has been punctured; the second does not occur if my procedure has been followed.)

When this has been done the syringe is taken off and filled with 15–20 c.c. of the anesthetic solution. This amount should be injected under moderate pressure within ten to fifteen seconds. One then waits three or four minutes before injecting the remaining 30 c.c. During this interval the condition of the patient is carefully watched in order that any manifestations of intoler-

ance to the anesthetic may be noted. In some cases, owing to the richly vascular nature of the peridural tissues the rate of deep anesthesia such as follows the ordinary subarachnoid spinal anesthetics has set in; (such deep anesthesia could occur if the

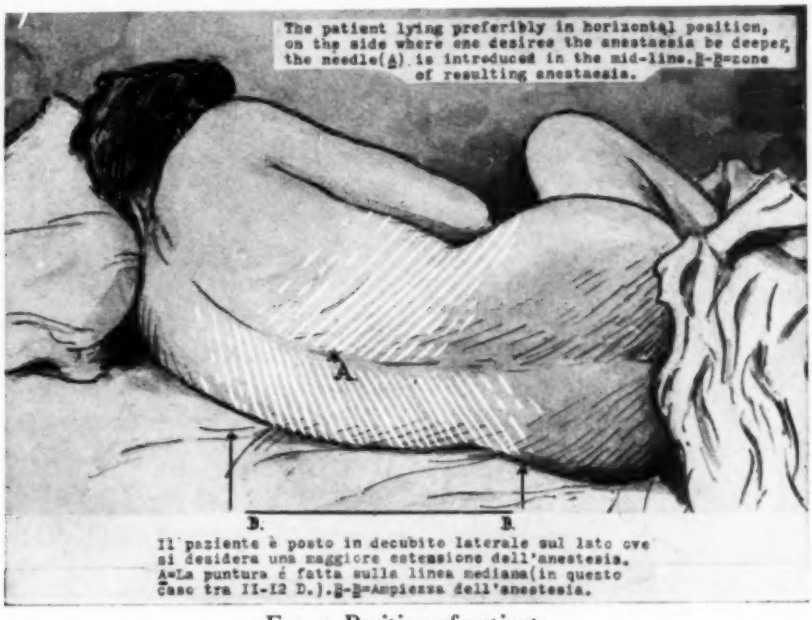
The patient lying preferibly in horizontal position, on the side where one desires the anestaesia be deeper, the needle(A) is introduced in the mid-line.B-B=zone of resulting anestaesia.
A
B.
B.
Il paziente è posto in decubito laterale sul lato ove si desidera una maggiore estensione dell'anestesia. A=La puntura é fatta sulla linea mediana(in questo caso tra II-I2 D.).B-B=Ampiezza dell'anestesia.

Fig. 9. Position of patient.

absorption is rapid so that symptoms appear very quickly. On the strength of my own observations I am inclined to believe that in the few cases (about 2 or 3 per cent) in which toxic symptoms occurred as a result of rapid absorption, (pallor, profuse sweating, small and rapid but occasionally slow pulse), such were due to the laceration of veins resulting from a too rapid infiltration of the peridural tissues. We did, in fact, notice that in nearly all these cases aspiration with the needle produced a blood-stained fluid. In a few cases such occurrences may be due to an excessive compression of the spinal cord as a result of the peridural injection or to a rise of pressure of the cerebrospinal fluid due to this. Such assumptions can, however, only hold good for the disturbances which occur almost immediately after injection. It would be worth while to investigate this matter more thoroughly.

During this waiting period of three to four minutes one makes certain that the general condition of the patient is satisfactory. One should also ascertain that no dura had been punctured in error). If one is then satisfied the remaining 30–40 c.c. may be injected. If an extensive area of anesthesia is desired this second injection is made fairly quickly so that the injected fluid may spread under increasing pressure in the peridural space and travel far enough up and down and particularly be able to overcome the resistance which is offered by the intervertebral foramina. As I remarked at the beginning, I consider it very important that the foramina should be infiltrated, for when this occurs, the solution is not only able to act on the spinal nerves within the spinal canal but may also, by traversing the foramina and entering the paravertebral tissue, act there likewise on the nerves, the rami communicantes and the ganglia and sympathetic trunks. The blockage of sensation in a given area will then be deep and complete. If it is desired to obtain a more strictly localized anesthesia, then the solution should be given in four or five separate doses of about 10 c.c. When this is done the fluid-spreads more slowly and is absorbed little by little. If

this modification be adopted, the peridural space will have taken up most of the fluid which, if injected by the first procedure would have inevitably spread some way up and down owing to the limited space available.

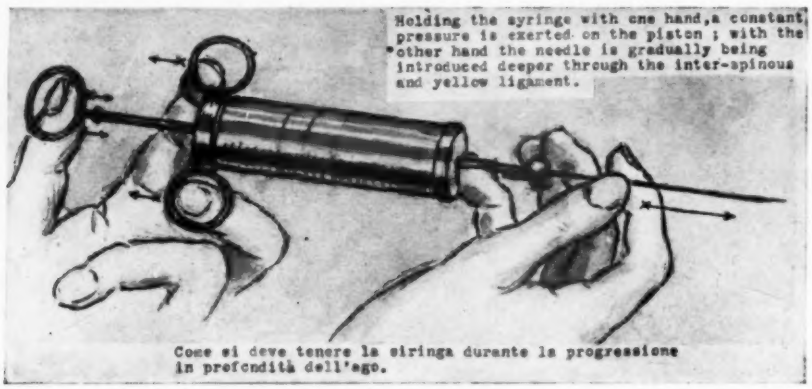
Holding the syringe with one hand, a constant pressure is exerted on the piston; with the other hand the needle is gradually being introduced deeper through the inter-spinous and yellow ligament.
Come si deve tenere la siringa durante la progressione in profondità dell'ago.

FIG. 10. Method of holding syringe.

The extent of the anesthetic area may also be influenced by changes in the strengths of the solution. For an extensive and bilateral anesthesia one should use a large quantity of a dilute solution (60–80 c.c. of 1 or 1.5 per cent novocaine or 0.1 to 0.15 per cent nupercaine given in from two to three times). For more localized and chiefly unilateral areas one may use with advantage concentrated solutions 2–2.5 per cent novocaine or 0.2 to 0.3 per cent nupercaine in several small doses. As I pointed out before and may here emphasize again, it is important, in all cases in which one side is to be rendered anesthetic, to have the patient lying on this side while the injection is made. He should remain in this position for ten to fifteen minutes.

I would advise all those who have as yet no experience with this method, to begin always with moderate amounts of a dilute solution and to give this in from 2 to 4 injections (60 c.c. given as 20 c.c. + 40 c.c. or as 15 c.c. + 25 c.c. + 20 c.c.).

ANESTHETIC SOLUTION

I have now tried a variety of preparations in different solutions. The best results are obtained by the use of physiological saline which is the most simple solvent to use and is therefore superior to others which might appear better on other grounds. In this connection it is only necessary to remember the long discussions which took place when infiltration anesthesia was first introduced and the innumerable suggestions which were made by a variety of writers on the subject. Keeping these in mind one is able to convince oneself that the simplest and the most harmless solution is invariably isotonic physiological saline. I have made use of the following anesthetics:

Novocaine, usually in 1–1.5 per cent solution.

Nupercaine in 0.2 or 0.1 per cent solution.

The solution should be freshly made up in a sterile vessel (preferably just before use). To 100 c.c. of solution one must add 2 c.c. of adrenalin immediately before use. Whereas novocaine and pantocaine act more quickly (anesthesia sets in after ten to fifteen minutes), it is necessary to wait fifteen to twenty minutes if nupercaine is used. The action of nupercaine is, however, stronger and more prolonged.

In a powerful adult the maximum amounts of solution which may be safely used are as follows:

Nupercaine		Novocaine	
0.1 per cent	80 c.c.	1 per cent	80–100 c.c.
0.15 per cent	45 c.c.	1.5 per cent	45–60 c.c.
0.20 per cent	30–35 c.c.	2 per cent	30–35 c.c.
		3 per cent	15–20 c.c.

Pantocaine should be used as nupercaine. The addition of 2 c.c. of adrenalin to 100 c.c. is essential.

INDICATIONS AND SUCCESSES

Up to the present we have used this method for 300 patients for a variety of conditions. With the exception of operations on the face and skull and those on the perineum and external genitalia (for these a sacral epidural anesthesia is to be preferred) a complete and adequate anesthesia may be obtained in the majority of all other operations on the thorax, the abdomen and lower extremities. In respect of the neck and the upper limbs our experience is too limited as yet for us to be able to give an opinion. At the moment I am studying the possibilities of applying the method to the neck also. Naturally, for operations on the abdomen, this method is at times somewhat limited and inapplicable though it also possesses many advantages for use in this field. We think that for simple procedures such as inguinal herniae and simple appendix operations undertaken in the quiescent stage, infiltration anesthesia is preferable on account of its simplicity and freedom from risk. For children and for very sensitive excitable adults, a mixed anesthesia or general anesthesia (gas, ether or rectal narcosis) is desirable.

For any extirpation of the internal genitalia in a woman or for an amputation of the rectum in a powerful patient we usually employ the classical subarachnoid method of anesthesia since this gives a more extensive and complete anesthesia of the nerves of the cauda equina.

Despite these limitations and some others which we have not mentioned, there yet remain numerous cases in which my method may be used with success; this is particularly the case with severe abdominal operations especially those in the upper abdomen involving the stomach, liver, bile passages, etc., or those in which gut has to be resected. For these it is ideal. The method is also suitable for use in the surgery of the kidneys and urinary passages and for operations on the walls of the thorax. If the patient is unsuitable for a general or a paravertebral anesthetic because of some general or local condition, or when a local infiltration anesthesia appears likely to be inadequate or too risky and a subarachnoid injection is probably dangerous because of a possible fall in blood-pressure or other complication (vomiting or subsequent headache) then one should make use of the method which I have described.

We may now summarize the *advantages of an anesthesia of this type when it is compared with the usual subarachnoid method.* It permits a complete anesthesia in any segment of the body to be obtained while leaving the deeper and higher lying parts unaffected. There is a corresponding limitation of the anesthesia to the area in which loss of sensation is desired; at the same time the dangers which are associated with the spread of the injected solution to the higher parts of the cord and the bulb are eliminated wheras in an ordinary spinal anesthesia they are occasionally present. The fall of blood-pressure is less in my method as a result of the spread of the anesthesia being controlled and also of the impossibility of any of the solution reaching the medulla. The frequent disturbances which are seen in spinal anesthesia, especially vomiting which is often obstinate and a great hindrance in abdominal operations, are very rarely seen. The frequency and severity of collapses during the induction stage are both much reduced; such collapse is usually due to severe vasomotor paralysis, impaired action of the heart and the spread of the anesthetic to the bulb. There is a similar diminution in the disturbances which come on later such as headache and pain in the back; these are reduced to a minimum. In none of our cases did any sequelae or complications appear which caused any anxiety.

When compared with *paravertebral anesthesia* my method has the advantage of greater ease and simplicity in its execution since only one puncture is needed. This one

puncture is, however, much more certain and effective since by it all the roots are with certainty exposed to the action of the anesthetic. In a paravertebral anesthesia, however, it often happens that one or more roots escape so that failure is common.

My method is superior to *local anesthesia* since it acts both on the superficial and deeper layers and viscera so that any operation is possible by its use. Anesthesia is moreover so deep that it can only be compared with that obtainable from an ordinary spinal anesthetic. Peridural anesthesia also possesses the advantage, when compared with local anesthesia, of causing no interference to the local nutrition of the tissues. It thus has no delaying effect or hindrance in the course of healing.

When compared with *general anesthesia* it will be seen to possess all the advantages and disadvantages of local and block anesthesia.

It is not possible in so short a communication as this to discuss in detail all the many featured and interesting problems in anatomy, physiology and clinical practice which arise from the use of this method. As soon as possible we propose to deal with these in the light of a more extensive experience. The results obtained to date are more than encouraging and I venture to hope that the method will meet with a benevolent reception from surgeons and anesthetists in all parts of the world; I also trust that it will be tried and improved by them.

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SIMPLE TECHNIQUE FOR INSERTING A SILK SETON

WITH REPORT OF ITS USE IN A CASE OF COMMUNICATING HYDROCEPHALUS & DESCRIPTION OF A SETON NEEDLE & SUGGESTIONS FOR ITS USE

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SILK SETON IN A CASE OF COMMUNICATING HYDROCEPHALUS

THE following case is recited with the hope that the knowledge gained through it may help to avert a similar tragedy in the life of some other child. The principle of treatment employed is not new. Setons have been inserted into the spinal canal and cerebral ventricles by numerous surgeons; but in nearly all instances the operations have been so formidable as to preclude repetition if drainage ceased. In this case, however, the procedure was reduced to such simplicity that it was repeated three times and could have been further employed had occasion demanded.

S. J. C., a white female child of six years, suffering with a tremendous congenital hydrocephalus, was seen by me for the first time January 22, 1931. During the two preceding days she had been suffering from a slight cold and had been vomiting.

Past History: In 1926, at the age of five months, the child had been carefully studied in Chicago, where she remained in the hospital for ten days because of diarrhea and enlargement of the head. Studies revealed the hydrocephalus to be of the communicating type. Dye introduced into the lateral ventricles was recovered from the spinal fluid. Wassermann and Kahn tests performed on the spinal fluid were negative. The fluid was described as clear, colorless, containing eight cells to the field, mostly lymphocytes, and showing a negative globulin test.

From May 17, 1926 to November 26, 1926 approximately seven spinal punctures were done on the child by a surgeon in Milwaukee. Quantities of fluid varying from 20 c.c. to 60 c.c. were withdrawn in order to reduce the spinal fluid pressure to approximately normal.

From November 26, 1926 to April 7, 1931, when the child was first tapped by me, compensation had evidently existed and no spinal or ventricular punctures had been done. The head had increased in size progressively until the circumference had reached 67.5 cm. The fontanelles were closed but over the site of the anterior fontanelle, an ossified bulge about the size of a grapefruit had formed. The child was, unusually intelligent, heard unusually well, but had limited vision. Horizontal and some rotatory nystagmus were present. She could sit up if her head was supported and could walk if she was supported. The heart was not enlarged and no murmurs were heard. The pulse rate was 104. The lungs and abdomen were negative to physical examination. The Achilles tendons were markedly shortened, but the knee jerks appeared normal. A bilateral positive Babinski reaction was obtained.

Progress of Case: The child recovered from the vomiting spell of January 22, 1931 by means of limitation of fluids and mild catharsis. On April 6, 1931, the mother noted that the child's vision was failing. The pupils reacted to light, but examination of the fundi disclosed marked optic atrophy. Relief of pressure was advised by the ophthalmologist. Twenty-five cubic centimeters of fluid were withdrawn by spinal puncture, reducing the pressure to normal. The fluid was yellowish in color; Wassermann and Kahn reactions were negative; and guinea-pig inoculations failed to show evidences of tuberculosis. The child was quite comfortable for ten days when pressure symptoms and projectile vomiting and slight convulsions again appeared. On April 16, 1931, 30 c.c. of fluid were withdrawn by spinal puncture. Spinal punctures were withheld as long as possible, but the intervals between the periods of pressure symptoms became progressively shorter.

Absolute blindness and deafness intervened.

Suggestions were sought from authoritative sources as to a means of restoring the child's hearing. The only suggestion received was that

ventricular punctures might be used in conjunction with spinal punctures. Accordingly, on May 12, 1931, a trephine opening was made in the skull at Kocher's point on the right side and 45 c.c. of fluid withdrawn from the right lateral ventricle. Recovery from the operation was uneventful. Subsequent ventricular punctures were made through this trephine opening at the patient's home. The interval between punctures continued to decrease until it was necessary to tap the child daily. The quantity of fluid withdrawn in order to reduce the pressure to normal also became greater and greater until on one occasion the total fluid withdrawn through the combined punctures amounted to 85 c.c. The more fluid withdrawn, the more accumulated. It appeared as though the withdrawal of large amounts of fluid decompressed the choroid plexus to greater secretion. It was then that the following technique for inserting a silk seton into the spinal canal to allow the escape of fluid into the muscles overlying the spinal column was conceived and executed:

Under aseptic precautions at the St. Joseph's Hospital, Milwaukee, three knots overlying each other were tied at the end of a piece of No. 3 black waxed silk. The patient was then placed on the operating table, the head of the table lowered, and a spinal puncture between the third and fourth lumbar vertebrae accomplished with a No. 17 spinal puncture needle. The depth of the spinal canal from the skin surface was noted and the piece of silk cut to be about ½ inch short of this distance. The stylet of the needle was then withdrawn and the knotted end of the silk forced into the shaft of the needle ahead of a No. 9 wire, twice the length of the spinal puncture needle. When the bulbous end of the silk was felt to pass the end of the spinal puncture needle, the wire was held in place by a hemostat and the needle withdrawn. The wire was then withdrawn and the operation was completed. No anesthesia was required.

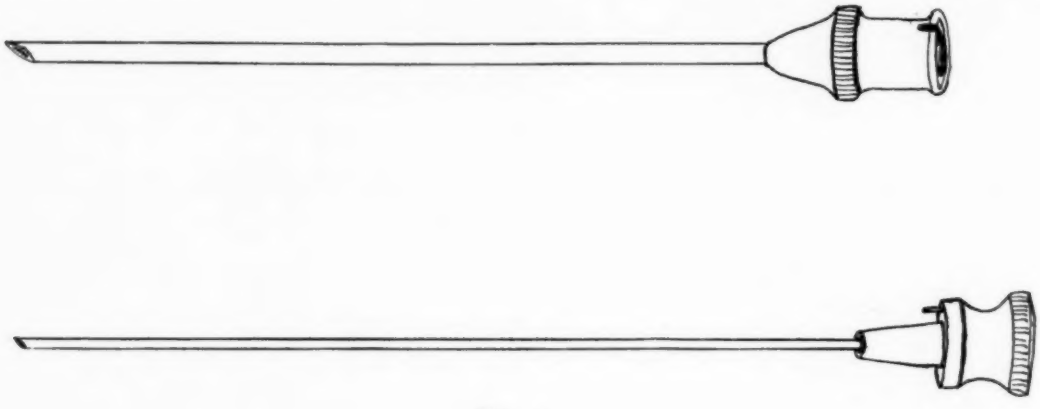

Fig. 1.

The one notable difficulty of the technique was the proper insertion of the bulbous end of the silk thread into the shaft of the needle since the diameter of the bore of the hilt of the needle was greater than that of the shaft and the knot had to be inserted against the outflow of spinal fluid. This difficulty, however, has been completely overcome by our needle.

The patient was removed to her home immediately after the completion of the operation. Her head was elevated on pillows and the mother instructed to place a hot water bag over the site of the puncture and to massage this site in order to promote greater subcutaneous absorption of the fluid. The effect was quite remarkable. Instead of requiring daily punctures, the child was comfortable for nearly three weeks. On July 11, 1931 symptoms demanded a repetition of the operation. On July 28, 1931, the operation was again repeated. On August 17, 1931 the fourth and last seton to date was inserted.

About one month after the insertion of the last seton, however, cerebrospinal fluid began to drain from the child's nose. This symptom continued until about April 15, 1932. The drainage then ceased, and with the exception of an occasional head cold, the child's course was uneventful until June 9, 1932 when I was called to remove several pieces of modeling clay from her left nostril. A polyp was also removed from the middle meatus of the right

nasal cavity. A plug of what appeared to be mucus about 1 inch in length and about 1/8 inch in diameter trailed after the polyp. That night the mother noticed that fluid again began to drain from the right nostril. Drainage continued for one week but has not been evident since that time.

Comment: In this case, although the drainage of cerebrospinal fluid from the nose perhaps perpetuated the good result, the actual procedure that turned the tide appeared to be the insertion of the setons. When the first seton was inserted, the child was vomiting almost continuously and required daily removal of large amounts of fluid. About three weeks of comfort followed the insertion of each seton and there certainly was no contraindication to repetition of the process had occasion demanded. The sad part of this case, however, is that blindness and deafness had already intervened before this technique was instituted and now, the child, bereft of contact with the world except through the sense of touch, has obviously deteriorated mentally. Although the method of treatment of communicating hydrocephalus in which the choroid plexus is either destroyed or removed has a more rational physiological basis than the insertion of a seton, the risk involved in the former procedure is so great as compared with that of the latter, that the employment of the seton technique would seem almost imperative as a primary measure. I feel confident that in certain cases in which only a small imbalance between absorption and secretion exists, the insertion of the seton may favor the patient just sufficiently to establish compensation.

Description of a Seton Needle and Suggestions for Its Use

This needle differs from a No. 17 gauge 3 inch spinal puncture needle only with respect to the hilt. The shaft of the needle has been extended through the hilt to eliminate the difficulty of starting the knotted end of the silk thread on its course through the lumen of the shaft of the needle. The tapering portion of the hilt of the stylet has been bored to accommodate the portion of the shaft of the needle which projects through the lumen of the hilt. An adaptor of the Record-to-Luer type fits the hilt of the needle perfectly so that injections or aspirations may be made, or pressure readings taken through the needle. A strand of No. 3 black waxed silk, and a No. 9 wire twice the length of the needle but marked at the half-way point, complete the armamentarium.

In performing the operation, one must be careful to cut the seton to the exact length required for the particular case.

Other possibilities for the use of this simple seton technique are:

1. In cases where the slow escape of spinal fluid is desired in order to reduce intracranial pressure as in fractured skull cases, wet brain of delirium tremens, and uremia.

2. In the tapping and slow draining of fluid collections such as ascites, hydrothorax, hydrocele, and Bartholin's cyst. However, one must have absolute control of the wire in cases of this type if he does not want to do unwarranted damage.

One of the prerequisites for the use of the technique is that the tissues through which the needle finally penetrates be of sufficiently elastic nature to grasp the knotted end of the silk thread when the needle is withdrawn and the thread held in place by the wire.

The operation has been accomplished by me in the case of communicating hydrocephalus here cited and in a case of Bartholin's cyst in which a seton was inserted and allowed to remain in place for a few days after which a new duct formed. It has not been tried in the other types of cases suggested but appeals to me as a very likely procedure in selected cases.

Summary

1. A case of communicating hydrocephalus is reported in which silk setons were inserted into the spinal canal by a very simple technique.

2. A needle is described which has greatly facilitated the procedure and further suggestions for its use.

INGUINAL HERNIOTOMY

A REPORT OF 1500 CASES, DEMONSTRATING ADVANTAGES OF TRANSPLANTATION OF SPERMATIC CORD EXTERNAL TO FASCIAL LAYERS*

HARRY R. HUSTON, M.D., F.A.C.S.

DAYTON, O.

THERE are few medical subjects of more interest to the industrial world than that of inguinal hernia. Recurrence of inguinal hernia, following operation, is a source of great financial loss to both employer and employee. Any surgical procedure which reduces the likelihood of postoperative recurrence to an almost negligible minimum is worthy of thoughtful consideration. With this aim in view we wish to report our experiences with an operative procedure which we believe to be mechanically sound, and which has yielded especially favorable results as regards recurrences.

This report is based upon the results obtained in 1500 consecutive inguinal hernia operations performed on male patients. Approximately four-fifths of these operations were done at the National Military Home Hospital, while the others were done at the Miami Valley Hospital, at Dayton, Ohio, during the six year period from February, 1924, to March, 1930. In this series were 1249 indirect inguinal hernias and 251 direct inguinal hernias. The patients ranged in age from eighteen to eighty-six years. From one to five herniotomies had been performed pre-

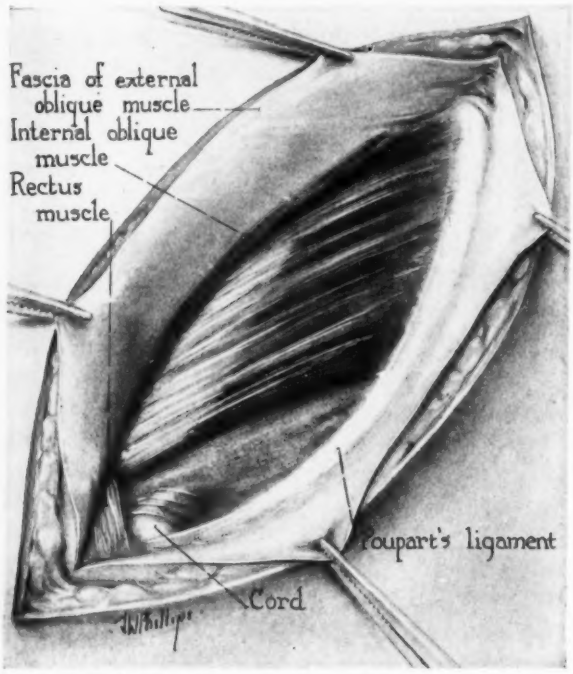

FIG. 1. Division and retraction of fascia of external oblique muscle, with exposure of conjoined tendon, Poupart's ligament and spermatic cord.

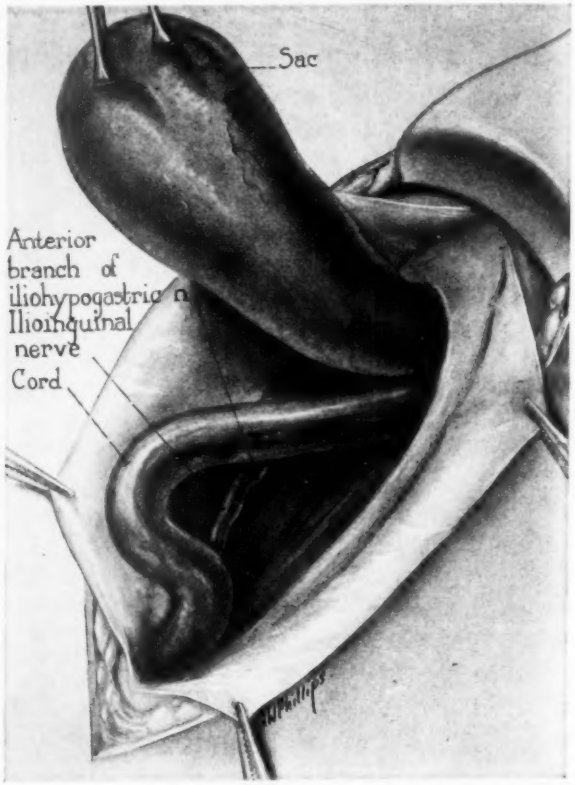

FIG. 2. Dissection of sac from spermatic cord and adjacent structures. Spermatic cord has been elevated from its bed.

* From the Surgical Divisions of the Dayton Clinic and National Military Home Hospital, Dayton, Ohio.

viously on 176 of these patients; there were no recurrences in this group of 176 patients following the operation which forms the subject of this report.

Among the 1500 patients who were subjected to inguinal herniotomy there were 12 recurrences, an incidence of 0.8 per cent. Eight of the recurrences occurred during the first six weeks following operation. In 3 cases, recurrence was attributable to postoperative hematoma; in 2 instances the cause was wound infection; in 2 cases recurrence was associated with pneumonia; in one instance the patient became intoxicated and indulged in a fist fight one week after dismissal from the hospital.

There were two deaths. One senile patient died of cerebral hemorrhage on the sixth day following operation. The other patient died of peritonitis on the eighth day following operation; at the time of operation the ileum was found to be strangulated in the hernial sac, with perforation of the wall of the intestine. Atrophy of the testicle occurred in 3 patients who were operated upon early in this series. This complication was overcome by modifying the operation to avoid compression of the spermatic cord structures.

The scope of this paper will be limited to a consideration of inguinal hernias, both direct and indirect. In this form of hernia one occasionally encounters a double, or so-called "saddle-bag" sac. We have found it desirable to convert the double sac into one sac and to repair the single sac in the same manner as is employed in the repair of a simple direct hernia. The sac may be constricted, or only a small portion of the hernial protrusion may be lined by a reflection of the peritoneum, as in the so-called "sliding hernia." There may be many adhesions behind the sac to the ileum, colon or omentum, as in the incarcerated hernia. It may contain a portion of the cecum and appendix. In two instances we have found the sac of an indirect inguinal hernia to contain a gangrenous appendix.

The most important complication of inguinal hernia is strangulation. The development of this unfortunate sequel carries with it the imminence of gangrene of the contents of the sac and, if a loop of bowel should be contained in the sac, intestinal obstruction. If the strangulation is not promptly relieved, death usually ensues. With this important consideration in mind we regard herniotomy for strangulated hernia as an emergency operation, provided we are unable to reduce the contents of the sac back into the abdominal cavity by *very gentle* manipulation. When the contents of the sac have been reduced by careful manipulation one must be certain that a small portion of the loop of intestine is not incarcerated in the neck of the sac. If this precaution is not exercised the strangulation will not be relieved. If the strangulated hernia cannot be promptly reduced by gentle manipulation, immediate operation is indicated.

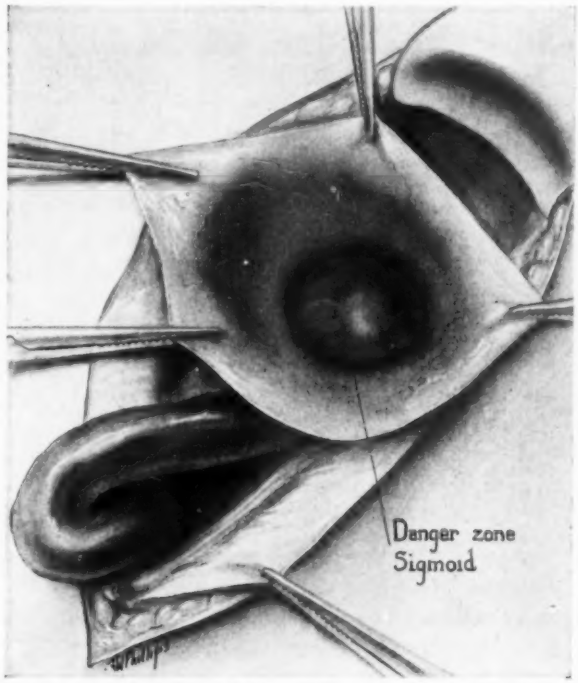

Fig. 3. Opened sac with exposure of sigmoid colon in dilated internal inguinal ring. Sac is closed from inside at its junction with parietal peritoneum, by a purse-string suture, thus avoiding injury to intestine, bladder or omentum.

The symptoms produced by direct or indirect inguinal hernia depend upon the size and nature of the sac and its contents, and whether or not it is reducible, incarcerated or strangulated. Bulging or pain, or both, are the common symptoms which cause the patient to consult his physician. Less common symptoms are reflex digestive disturbances, cramps and gas formation. Large external hernias often produce great incapacitation, particularly in persons who perform heavy manual labor.

The diagnosis is generally reached after the history has revealed the symptoms common to this disease and the examination discloses the defect of the inguinal ring, through which one may or may not be able to reduce the hernial protrusion. Reduction of the contents of the sac is usually quite impossible if incarceration has occurred. The differential diagnosis of hernia from hydrocele, varicocele and neoplasm is a matter of great importance.

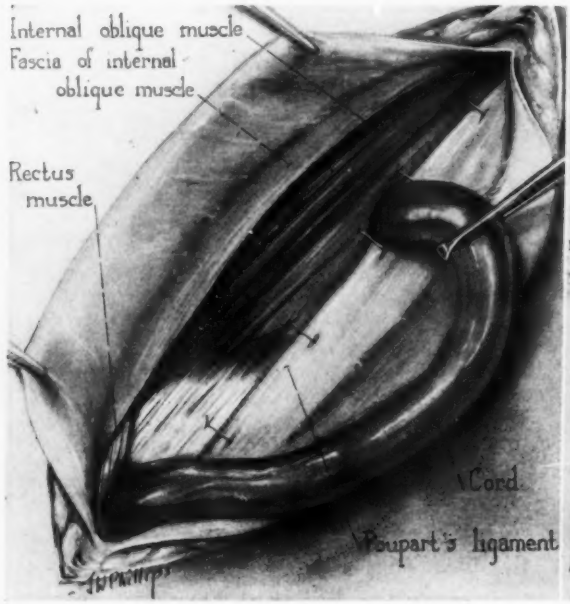

Fig. 4. Attachment of internal oblique muscle and conjoined tendon to Poupart's ligament. From three to five sutures are placed below reconstructed internal ring and two sutures are placed above cord.

Fig. 5. Use of a portion of upper leaf of fascia of rectus abdominis muscle as an additional support in cases in which defect at external inguinal ring is unusually large.

OPERATION

The operation which we have employed since 1924 in the treatment of direct and indirect inguinal hernias in adult male patients is performed as follows:

The skin incision is made approximately 2 cm. mesial and parallel to Poupart's ligament, beginning at the level of the anterior superior spine of the ilium and extending beyond the external inguinal ring. The subcutaneous tissues are divided down to the aponeurosis of the external oblique muscle. The aponeurosis is then cleared of all loose areolar tissue. If there is no separation of the fibers of the aponeurosis it is divided in the direction of the fibers. The division of the aponeurosis is made so that when it is extended it either divides the external ring in equal halves, or lies just to the inner side of the external ring. The two edges are then grasped with hemostats and the aponeurosis is dissected back on either side (Fig. 1). It is important to completely expose Poupart's ligament laterally and to dissect the aponeurosis free from the internal oblique and conjoined tendon mesially. The lower half of the internal oblique muscle is dissected free from the vessels, nerves and spermatic cord structures. The cord is then picked up;

the cremaster muscle and fascia, and the infundibuliform fascia, are incised, which exposes the sac and the spermatic cord.

The sac is closed from the inside, where it begins to widen out and to blend with the parietal peritoneum, by a purse-string

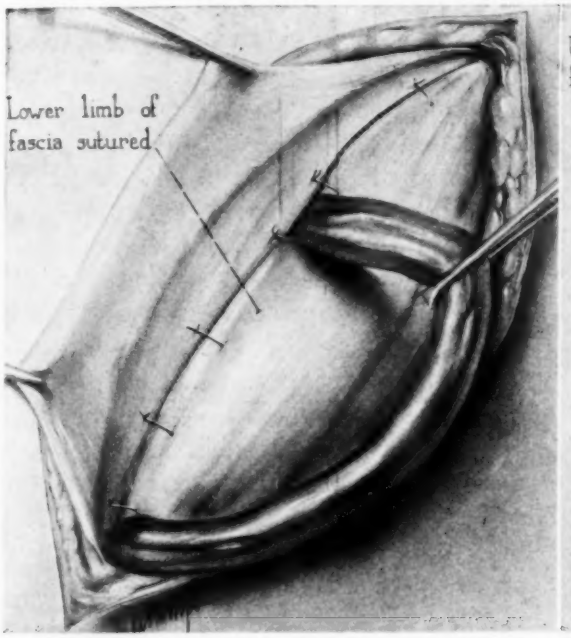

Fig. 6. Suturing of lower limb of fascia to muscle and conjoined tendon under spermatic cord.

Fig. 7. Suturing of upper limb of fascia with a niche in fascia adjacent to spermatic cord to prevent compression of cord structures.

In the oblique form of inguinal hernia the sac is almost always found anterior and mesial to the spermatic cord. If the sac is small it will usually be found near the internal inguinal ring. When the sac is located it is picked up and by blunt and sharp dissection is freed from the cord (Fig. 2). In many instances as one approaches the neck of the sac a pad of extraperitoneal fat will be encountered; we have found it wise to dissect this free from the sac and excise it. Dissection of the sac is continued until the narrow part of the neck is freed and the sac begins to widen. The sac is then opened to a point near the internal inguinal ring (Fig. 3). An exploration of the peritoneal cavity adjacent to the inguinal ring at this time occasionally reveals the presence of another hernial sac. Too much emphasis cannot be placed upon the advisability of searching for an additional hernial sac; the likelihood of recurrence is greatly diminished if a second sac is found and properly repaired.

suture. By following this procedure the danger of accidentally puncturing the bladder, omentum, or intestine with the ligature needle, is avoided. The sac is then excised, and the edges of the stump are whipped over with the same suture which was used in the purse-string closure. The stump is usually transplanted well up under the internal oblique muscle, avoiding injury to the blood vessels. The cord is then freed from its pad and retracted upward with an Allison forceps.

The next procedure is to prepare a new floor for the spermatic cord. The spermatic cord is retracted laterally and the first suture is made at the lower end of the inguinal canal. The outer portion of the conjoined tendon is picked up and passed beneath the cord and attached to the inner shelving edge of Poupart's ligament, close to the point of its attachment to the pubic spine. If possible, part of the periosteum of the pubic bone is included in the suture;

this suture is not tied until all of the deep sutures have been placed.

The next suture is placed just above the first one; this includes the conjoined tendon if possible. If this is not possible the suture extends through the internal oblique and transversalis muscles and is attached to the inner shelving edge of Poupart's ligament. It ordinarily requires from three to five sutures to complete the closure of the first layer; the sutures are placed approximately ½ inch apart. After these sutures have been tied, two sutures are tied above the cord, as recommended by Coley (Fig. 4); this will avoid recurrence of herniation above the cord. Occasionally, it will be found desirable to turn down a small portion of the upper leaf of the fascia of the rectus abdominis muscle to cover over a large defect of the external inguinal ring (Fig. 5).

Fig. 8. Closure of superficial fascia and fat over spermatic cord as a protective pad.

The lower flap of the aponeurosis is then brought up behind the spermatic cord and attached to the conjoined tendon (Fig. 6). To prevent constriction of the cord a niche ½ to ¾ inch in length is made in the aponeurosis of the external oblique at the new external ring; a suture is then applied to close the incised portion of the aponeurosis adjacent to the spermatic cord. Following this the upper flap of the aponeurosis is brought down behind the cord and attached to the outer edge of the conjoined tendon adjacent to the newly constructed external ring. It may be desirable at this point to make another niche in the aponeurosis to prevent constriction of the cord. Above the cord, the aponeurosis is imbricated and attached to the lower flap of the aponeurosis and femoral fascia (Fig. 7). This provides a floor behind the cord which is composed of three firm layers. The cord is then covered by subcutaneous fat and skin, which act as a protective pad (Fig. 8).

Number 1 twenty-day chromic catgut sutures are used throughout, except in the closure of the subcutaneous tissues, where plain catgut is used. In occasional cases in which the fascia was found to be unusually weak, either as the result of several previous operations or as a congenital defect, a strip of fascia lata, about 3 inches wide, has been transplanted over the line of sutures of the aponeurosis of the external oblique; this fascial transplant is sutured in place behind the cord.

In the operation upon a recurrent inguinal hernia it is wise to convert it back to a simple hernia, by completely exposing the spermatic cord and hernial sac in the manner already described. The tissues are then reconstructed in the same manner as with a hernia which had not been previously operated upon. In cases of strangulation in which a portion of the bowel is found to be gangrenous, resection of the necrotic bowel is done, followed by anastomosis. The bowel is then dropped back into the abdominal cavity and the operation is carried out as for a simple hernia.

One of the most important factors in the prevention of recurrence is adequate control of the postoperative treatment. Our patients have been strictly confined to bed

for two weeks. They are permitted to leave their beds on the sixteenth day, and to return to their ordinary occupations from six to eight weeks following the operation. In those cases in which several recurrences have occurred, or in which unusually large direct hernias were encountered, the patients were required to remain in bed for three weeks.

Local anesthesia was employed in practically every case in which the patient was over sixty years of age. The majority of the operations during the first three years of this six year period were done under nitrous oxide-oxygen anesthesia. During the past three years spinal anesthesia has been the method of choice. We have found spinal anesthesia to be the most satisfactory method for herniotomy in properly selected cases. It provides perfect relaxation. The fascia can be closed with equal tension on all points and the hazards of postoperative vomiting and postoperative pneumonia are eliminated.

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CIRCOID ANEURYSM

WITH REPORT OF AN UNUSUAL CASE

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CIRCOID aneurysms (pulsating angioma, aneurysm by anastomosis, racemose aneurysm, etc.) have been known for a long time. They have been generally considered neoplasms. Matas,[1] MacCallum,[2] and Delafield and Prudden[3] classify them as such. Ewing[4] speaks of them as partial tumors. Aschoff[5] considers them as arterial angiomas. Gross[6] regarded the condition as an arterial tumor. Billroth[7] denied they were tumors and thought them inflammatory. Ashhurst[8] said that in these tumors not only the arteries but also the veins and capillaries were dilated and involved.

Although the prevailing opinion is that circoid aneurysms are neoplastic many authors have noted the similarity between circoid aneurysms and arteriovenous fistulae and a few believed that the same cause explained both conditions, namely an abnormal communication between arteries and veins. Stanley,[9] Wright[10] and Wernher[11] all believed that circoid aneurysms were similar to arteriovenous aneurysms. Halstead[12] sites the congenital arteriovenous similarity. Meleney[13] demonstrated both arteries and veins in his operative specimen and believes them to be abnormal anastomoses. Reid[14] demonstrated free communication between the arteries and veins and reported 11 cases. He says that circoid aneurysms are the result of abnormal arteriovenous communications between the small peripheral arteries and veins and they are in no sense neoplastic.

FIG. 1. Two large venous sinuses at upper and lower levels with numerous smaller arteries, veins and capillaries.

Wagner[15] expressed the opinion that circoid aneurysms may arise in four different ways: (a) from a nevus or telangiectasis; (b) from a deep congenital anomaly of the blood vessels; (c) from a single severe trauma; (d) from a long-continued series of slight trauma.

Types a, c and d are borne out by the reported cases in the literature. Wagner believes most are congenital. Later writers stress trauma, especially contusions, as the most frequent cause of circoid aneurysms. Occasionally infections are responsible, i.e. by eroding the vessels, rarely operative incisions, etc. They commonly develop in angiomas, but even then trauma is a factor.

The head is the site of the majority of circoid aneurysms on account of the vascularity of the scalp[16] and the proximity of bone. Other sites have been reported, i.e. the hand,[17,18,19] knee, foot,[14,20] uterus,[21] mesentery,[22] etc. Occasionally children are born with circoid aneurysms. Reid[14] reported the case of a woman of twenty-nine, who had three operations on the foot before a complete cure was obtained.

According to Reid, arterial angiomas are dilatations caused by a traumatic or congenital abnormal communication between the smallest arteries and veins. They are arteriovenous communications, without the medium of capillaries, between the arterioles and venules. On a smaller scale they possess many points of similarity to both arteriovenous and circoid aneurysms. The free abnormal arteriovenous communication in the latter two usually leads to a widespread enlargment and dilatation of the neighboring arteries and veins, differing from angiomas only in their pulsatile nature and rapid enlargement. Angiomas are the common site or origin of circoid aneurysms.

The physical signs vary with the duration and extent of circoid aneurysms. A swelling with a continous thrill and bruit is present. All vessels involved (arteries and veins) pulsate. The proximal arteries and veins are more prominent and the distal ones less so. Later in the disease ulceration and hemorrhage may occur. An arterial angioma, on the other hand, is composed of arteries and veins that contain arterial blood. It is circumscribed, does not pulsate but may vary in size under stress, etc. The continuous thrill and bruit are absent.

In all arteriovenous aneurysms the collateral circulation is developed extensively. The proximal dilatation of the arteries often causes the walls to thin out and in circoid aneurysms the walls often rupture into one another. Holman[23] studied the changes in the heart. Cardiac hypertrophy which invariably occurs in true arteriovenous aneurysms is rarely associated with circoid aneurysms until very late. The local temperature is slightly higher than on the normal side, though below such an aneurysm the temperature is lower. A circoid aneurysm or an arteriovenous aneurysm in an extremity of a growing person may cause a considerable increase in the length of the extremity.

The treatment of circoid aneurysms is surgical. Though they are well tolerated for some time they should be operated upon early to prevent progressive enlargment. The technical details vary with the site and size of the aneurysm. Simple ligation of the large arteries proximal to a circoid aneurysm rarely ever suffices to cure. Direct attack on the circoid aneurysm, often preceded by a proximal ligation of arteries, offers the best hope of a cure. With the free anastomoses between the peripheral arteries there is little wonder that the arteriovenous anastamoses, which cause the circoid aneurysms, should remain active, and that other smaller feeding arteries should soon enlarge following the ligation of large proximal arteries. Stanley[9] remarked that the arteries probably dilate in order to supply the demands of the diseased structure, and if cut, they will soon be replaced by others.

The number of surgeons who disapproved of proximal ligation grew, so that other procedures were soon adopted: strangulating the aneurysmal mass, injec-

tions of astringents, etc., and excision. The latter procedure proved to be the only rational one and should be performed early before extensive vascular changes occur to render the condition inoperable.

CASE REPORT

Miss M. C., aged forty years, was first seen on March 11, 1931. She had noted a gradually enlarging tumor on the ball of the right foot for about five months. There was no history of any trauma except that could be ascribed to badly fitting shoes. She had been treated with arches and pads without relief. She had noted that the right foot was warmer than the left.

Examination revealed a soft swelling over the ball of the right foot about 1 inch in diameter, diffusely circular, bluish, pulsatile and expansile. A definite thrill and bruit were present over the tumor. The dorsalis pedis pulse on the right foot was very prominent and the posterior tibial was less so. The veins of the right foot were distended, more so distally and had a palpable pulse. The entire right foot was abnormally red and the right foot and leg much warmer than the left. The pulsatile characteristics of the tumor were synchronous with the dorsalis pedis pulse and could be abolished by occluding this artery. The distended veins also diminished in size after manually occluding the same artery. The upper extremities and left lower were absolutely normal. The heart examination revealed no hypertrophy. The blood pressure was 120/80, urine and blood examinations were normal. The Wassermann reaction was negative. The *x*-ray pictures revealed slight bone atrophy of the entire right foot (disuse), more marked over the head of the first metatarsal (pressure?). The oscillometer readings of the leg were:

	Upper calf	Ankle	Foot
R:	8.0	4.0	2.0
L:	7.0	2.0	0.5

The readings on the left were normal while those on the right were exaggerated. As conservative treatment by others had previously been unsuccessful, an operation was performed on March 23, 1931, under gas-oxygen anesthesia.

A hockey-stick incision was made over the ball of the right foot a little to the outside of the aneurysm. The skin was reflected back and a profusely bleeding circoid aneurysm encountered. With the use of a tourniquet the entire mass was excised and a communication demonstrated with the branch of the dorsalis pedis artery that communicates with the posterior tibial in its course between the heads of the first and second metatarsal bones. Hemostasis was obtained and a complete skin closure made. An external pad for pressure was applied over the site of the excised mass. The patient was discharged in seven days, completely healed and walking.

The pathological slide demonstrates that the excised structure consisted of numerous small and medium size veins and arteries with numerous smaller capillaries and large venous sinuses. (Fig. 1.)

Follow-up examinations six months and one year after operation revealed no evidence of any recurrence and the pulses on the right leg were normal with no evidence of any distended veins.

This clinically and pathologically is an unusual case of circoid aneurysm in the sole of the foot, completely cured by radical excision.

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[For Remainder of References see p. 127.]

REVALUATION OF THE PREVAILING THEORIES AND PRINCIPLES OF PUERPERAL INFECTIONS

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THE incidence of puerperal infections in our country is, according to the computations of C. Jeff Miller, made in 1930, from 25 to 30 per cent, and the mortality among the infected puerpera from 30 to 45 per cent. England and Wales are in a similar plight. Polak in a report before the Committee on Prenatal, Maternal and Early Infant Care, stated that for the past fifteen years our death rate from postpartum infections has remained stationary. Stander stated "that one in every 125 women die incident to child bearing: a truly staggering sacrifice." Nothing has been accomplished in the past quarter of a century to reduce this frightful death rate incident to childbirth. In sharp contrast to these appalling figures, Sigwart furnished statistics from the Frankfort clinic, showing a postpartum morbidity of 7.22 per cent, and a mortality as low as 0.137 per cent.

This striking difference between our statistics and the German is a direct challenge and indictment of American obstetrics. The fact that we made enviable advances in all branches of medicine during the past twenty-five years except in the prevention and treatment of puerperal infections indicates a temerity in our obstetrical minds to accept innovations and an undue reverence for tradition. The interests of American motherhood demand a revaluation of the traditional teachings of the bacteriology, the pathology and the treatment of puerperal infections.

BACTERIOLOGY

The contagiousness of puerperal fever, first recognized by Oliver Wendell Holmes in 1843, and verified by Semmelweis in 1847, stands as an irrevocable truth to this very day. The founding of bacteriology on a scientific basis by Pasteur has further substantiated this fact, and has opened newer and wider vistas for the study of bacterial infections and immunology. In 1868 Coze and Felz found, for the first time, streptococci in the blood of a woman dying of puerperal sepsis. Ten years later Pasteur succeeded in obtaining pure cultures of streptococcus from the blood of infected puerpera. These discoveries led Bumm, Widal, Chaveau and others to assume that the streptococcus is the only bacterium capable of causing puerperal fever; and this assumption still prevails in some clinics.

As the science of bacteriology grew, newer truths came to light. It was found that the streptococcus is not always pathogenic, for it was recovered from the birth canal of gravida and parturients who were perfectly well. The morphologic distinction of a bacterium as an indicator of pathogenicity has therefore, lost its importance, and resort was had to tinctorial and cultural investigations. But these lines of research also failed to establish the desired differentiation between virulent and avirulent microorganisms; as it was found that streptococci of the same staining, growing and formative characters showed widely varying pathogenic properties. A still further complication arose when it was discovered that other bacteria besides the streptococcus may also cause postpartum infections.

In 1897 Bordet showed that the characteristic of the virulent streptococcus is its hemolytic property. This fact was immediately accepted as a guiding rule, and Schottmüller postulated "the only type of bacterium capable of giving rise to puerperal fever is the hemolytic streptococcus." Veit Stated: "the non-hemolytic

streptococcus may be considered as avirulent." Fromme was of the same opinion at first, but when hemolytic streptococci were found in the vaginal and cervical secretions of afebrile puerpera, he relinquished this theory. Sigwart has shown that hemolysis is not an inherent but an acquired property of the streptococcus, conditioned by its culture medium, and came to the conclusion that the *severity of a postpartum infection does not depend so much upon the factor of hemolysis, but rather upon the numerical preponderance of the streptococci in a given infection.*

It seems to me that Sigwart's studies furnished the basis for Phillips's work on the determination of bacterial virulence. The theory of hemolysis as an indicator of bacterial virulence has also lost in importance when it was found that "non-hemolytic streptococci could also be fatal" and "that non-pathogenic streptococci of the primary host could become highly pathogenic when transported to another healthy puerpera."

The doctrine of *bacterial penetrability* promulgated by Doerderlein, Bumm and Olshausen, and sustained by Williams, DeLee, Sigwart and most of the present-day authorities has also failed to clear the bacteriologic concept of puerperal infections. We are taught that puerperal infections are divisible into three main groups or entities: (1) *Sapremia*, caused by saprophytes, microorganisms that dwell in the superficial necrotic layers of a wound. They cause a *wound intoxication* with mild constitutional reactions. (2) *Toxemia* or toxinemia, a parasitic disease. These bacteria possess a moderate degree of penetrability, produce a *wound infection*, and give rise to more marked reactions. (3) *Bacteriemia*, an infection with bacteria of the highest penetrability, in which the organisms gain access to the blood stream, grow and multiply therein, and cause the most dire results.

Kroenig also adopted the above classification, but admitted that sapremia may at times be fatal; and DeLee states that in some cases of toxinemia, a bacterial invasion of the living tissues may occur.

Schottmüller proved beyond the shadow of a doubt that in the so-called sapremias, bacteria are found in the living tissues as well as in the necrotic layers. Furthermore, that the supposedly harmless saprophyte may at times become a pathogenic parasite, and that a virulent bacterium may play the role of the avirulent form. Winter and Latzko have, therefore, asked the pertinent question: "How we can distinguish between sapremia and septicemia, when saprophytes can show parasitic qualities, and parasites live frequently as saprophytes?"

Analyzing critically these uncontrovertible antinomies in the bacteriology of puerperal fever, we must admit that the accepted tenents are no longer tenable. We are now convinced that bacterial morphology, staining and cultural properties, the factor of hemolysis, penetrability and the interchange of roles between virulent and avirulent types do not serve as reliable and dependable guides in the determination of the course, the outcome and the treatment of a puerperal infection. What sounder principles and surer guides have we?

Schottmüller's teaching that "all puerperal fevers are caused by an invasion of bacteria into the blood stream, in varying amounts and at varying intervals" is the soundest of all, and leads to the formulation of this guiding principle: "*The location of the septic focus, the depth and extent of the bacterial invasion and the frequency with which pathogenic bacteria gain entry into the blood stream, are by far more decisive factors in the prognosis and the treatment of puerperal sepsis, than are the laboratory determinations of bacterial virulence, or the pathologic study of bacterial penetrability.*"

The dogma that in bacteriemia the offending microorganisms settle and multiply in the blood stream is another error which needs correction. Bumm, DeLee, v. Herff, Jochmann, Kolle, Lexer, Tweedy, Williams and others adhere to this teach-

ing. Schottmüller, on the other hand, denies the possibility of this occurrence in the human species, and claims that thus far no one has succeeded in disproving his contention. Hamm and Latzko agree with Schottmüller; the latter says: "The circulating blood of humans cannot act as a nutrient soil for bacteria." Sigwart's refutation of Schottmüller's claim, with the finding of bacteria in the lumen of a vein obtained from the uterine wall of a patient who died of puerperal sepsis, is not conclusive. A close examination of his photomicrographs shows that the bacteria are located in the upper layers of the thickened endothelium, from where they were swept into the blood current. It is the endothelium, therefore, in endophlebitis, like the endometrium in endometritis, that constitutes the septic focus, and not the blood as such. The importance of this fact will become more apparent when discussing later on the subject of thrombophlebitis.

The essential facts to be obtained in the study of a puerperal infection are: (a) a bacteriologic examination of the vaginal and cervical secretions, and the blood; (b) a careful bimanual palpation of the uterus, the adnexa and the parametria; (c) a study of the temperature curves; (d) an estimation of the patient's resistance; (e) a sedimentation test, and (f) an ascertainment, if possible, as to whether the infection is autogenous or not. These points will be discussed seriatim.

(a) *Bacteriologic examinations* of the vaginal and cervical secretions and of the blood should include *anaerobic as well aerobic cultures.* The blood must be withdrawn *rom three to five hours before the onset of the chill,* and not during or immediately after it, as is the custom. The reasons for the latter demand are: The chill is an outward expression of a successful struggle between the defense mechanism of the body, and the endotoxins liberated into the blood stream from the destroyed bacteria. This bacterial lysis takes place as a rule from three to five hours after the offending microorganisms have entered the circulation. It, therefore, stands to reason that if the blood is taken immediately before, during, or after the chill, the chance of recovering bacteria at that time is very poor, except in the severest forms of sepsis, when the influx of bacteria is continuous, and the resistance, nill.

(b) *A careful bimanual examination of the uterus, the adnexa and the parametria, as soon as fever develops* after a spontaneous or an artificial abortion, or after a normal or instrumental delivery, is *obligatory.* This, too, is in contrast to the accepted dictum, which is founded upon the traditional fear that the pelvic manipulation would spread the infection. I do not wish to belittle the truth of this claim, but when we bear in mind that the location of the septic focus, and its surgical removal, are the most important factors in the prognosis and treatment of sepsis, then the obtaining of this valuable information outweighs in significance and advantage the slight harm that may result from forcing a few more bacteria into the circulation, in consequence of a pelvic examination. The danger, if any, can be greatly minimized by gentle palpation. The points to be noted in making a vaginal examination are, whether the external os is open or closed; whether the uterus is tender or not; whether the pelvic connective tissue is soft or hard, and whether the hypogastric, the spermatic or the uterine veins are thickened or not. These positive and negative findings determine the fate of the infected puerpera.

Schottmüller speaks of the importance of the "focus of infection" as follows: "*Every bacterial infection is accompanied by an intoxication; their association is inevitable. To combat the latter we must eliminate the former.*" The success of our treatment depends, therefore, upon the accessibility of the septic focus and the thoroughness of its removal. The paramount importance of the site of the septic focus as a decisive factor in the outcome of a bacterial infection is summed up by Schottmüller thus: "As long as the endo-

metrium alone forms the septic focus, the accompanying streptococcus bacteremia may be considered as almost harmless."

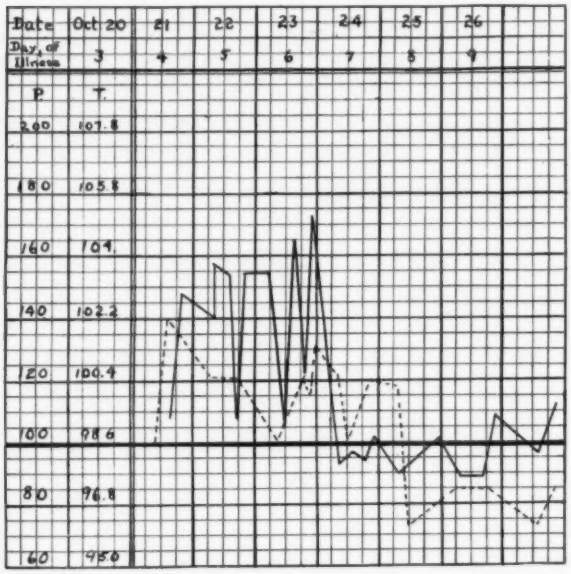

FIG. 1. Septic endometritis. (After Schottmüller.) L. L., twenty-four years of age; septic abortion, curetted on October 22, immediate drop in temperature. Uterus was septic focus. With each rise in temperature there was an accompanying chill. Cured.

If, however, the "parametrial lymphatics" become the septic focus, the mortality rises to 50 per cent. When the "pelvic veins" become involved, the mortality ascends to 90 per cent; and when the "endocardium" is the focus of infection, the mortality reaches 100 per cent. An illustrating example of the soundness and scientific truthfulness of these postulates is the following clinical experiment of Schottmüller:

A woman was admitted to his clinic for a medically indicated interruption of an early pregnancy. Under the most aseptic precautions a tent pessary was inserted into the cervix, and soon thereafter 20 c.c. of blood were withdrawn for culturing. A few hours after the introduction of the tent, the temperature rose to 100°F. and twelve hours later a curettage was performed, which was followed by a drop in the temperature to normal (Fig. 1), and it stayed at that level until the discharge of the patient. The blood culture yielded a positive finding of the Fraenkel gas bacillus.

The two valuable lessons taught by this clinical experiment were: (1) That every infection is a blood infection, no matter how mild the clinical course; and (2) that the most virulent infection may be deprived of its pernicious effects if the septic focus is removed early.

(c) *The study of the temperature curves in puerperal fever is of prognostic and diagnostic value.* When the temperature remissions are very pronounced, and the febrile intervals are prolonged, and following the chill the patient feels as if completely restored to health, it indicates a severe infection with good resistance.

(d) *Estimation of the patient's resistance to a bacterial infection.* Curschmann in 1902 was the first one to show that in all bacterial infections there is an increased leucocytosis. The full significance of this discovery could not be realized until Ehrlich discovered the method of vital staining, which enabled us to differentiate the various forms of white blood cells. The literature on the hematology of sepsis is voluminous, and, as clinicians, we need not lose ourselves in the fascinating nitricacies of this vast problem; but we must stand sufficiently close to the scientific advances in hematology, in order to utilize that which is of proved clinical value, and remain sympathetic to those views which are still in the throes of scientific investigation. The following facts in the hematology of puerperal infection are worthy of note.

The white blood cells are differentiated according to their affinities for acid, alkaline, neutral, or both acid and alkaline dyes, into four main groups: (1) eosinophiles; (2) basophiles; (3) neutrophiles; and (4) amphophiles.

Of these four groups the polymorphonuclear neutrophiles are of greatest importance in combating bacterial infections. They constitute about 75 per cent of the white blood cells, and are derived from the bone marrow. Arneth was the first one to call our attention to the fact, that while normally the polymorphonuclears

outnumber the mononuclear neutrophiles, in infections the opposite occurs. The neutrophiles are the main defenders against a bacterial invasion. Of the two types, the polymorphonuclears represent those that carry the brunt of the burden, for they are the well trained and hardened soldiers, while the monuclear neutrophiles are the young and inexperienced recruits. The conclusion follows, that the larger the polymorphonuclear count in a case of sepsis, the better the prognosis; on the other hand, if the count is in favor of the mononuclear neutrophiles, the outlook is graver.

Valuable as these facts are, they cannot be considered as absolute. Philipp and Fuss have shown that there is no positive relationship between the severity of an infection and its leucocytosis. They were able to observe instances of mild and severe sepsis, accompanied by the highest as well as by the lowest leucocyte count. They have, therefore, insisted upon a *combined hematologic and bacteriologic study in every case of puerperal infection*, in order to be able to estimate more accurately the aggressiveness of the foe, and the combativeness of the attacked.

(e) *The sedimentation test:* Linzenmeier described it first. The technique of the original method has undergone many modifications and simplifications, and its observance has been extended to other pathological and physiological states (like pregnancy), besides bacterial infections. Among those who contributed to this branch of knowledge, I shall mention but few: Westregren; Fahreus; Bland, Goldstein and First; Mathieu, Trotman, Haskins, Osgood and Albert. The importance of this test is unquestionable, but like any other laboratory aid in diagnosis, prognosis and treatment, it must be weighed carefully in the scales of clinical experience; and if our clinical judgment dictates surgical intervention, a rapid sedimentation index should not deter us from carrying out the planned operation. This has been my own experience, and my therapeutic results have strengthened my belief in the correctness of this attitude. The only bacterial infection in which a rapid sedimentation rate is an absolute contraindication to surgical intervention is the gonorrheal, affecting the pelvic organs, particularly the fallopian tubes. The inestimable gain from waiting until the acute gonorrheal inflammation has subsided, as indicated by the prolongation of the sedimentation time, accrues not from the avoidance of a general peritonitis that may be induced by surgical treatment, a fear which has been unduly exaggerated, but rather from the fact that waiting will eliminate surgical intervention altogether in very many cases. For by the time the sedimentation rate approaches the normal, the salpingitis will have also subsided in the majority of instances to a state no longer requiring removal, with a restitution of the patency and perhaps also the potency of the fallopian tubes to an almost normal state.

(f) *A consideration of puerperal infections must also include the problem of autoinfection.* Autoinfection can and does occur in gravida and puerpera. This was proved scientifically by Ahlfeld in 1897. Aschoff in 1911 classified puerperal autoinfections into endogenous, ectogenous and exogenous. From an academic and from a forensic point of view these classifications are important. It would, however, serve the welfare of our patients best if we were to lock this knowledge in a subconscious compartment of our brain, and never permit it to come to the surface of our medical consciousness. It is a much safer and sounder teaching to adhere unswervingly to Bumm's dictum "*Die Gefahr kommt von Ausen*," and thus maintain an eternal vigilance on asepsis.

PATHOLOGY AND TREATMENT

Any break in the continuity of the tissues of the generative tract may serve as a portal of entry for pathogenic bacteria. The most common foci of infection in their order of frequency are: the endometrium;

occasionally the myometrium; the parametrial lymphatics; the pelvic veins; and the endocardium. In these foci the bacteria settle and multiply, and from them they find their way into the circulation in greater or lesser amounts, with varying frequency, thus producing mild, moderate or severe grades of sepsis. For the sake of clarity and didactic expediency, it is best to consider these four main lesions of puerperal sepsis separately, and at the same time bear in mind that they do not constitute absolute pathologic divisions, for as the infection continues, one form merges into another, and more than one type of lesion may exist simultaneously from the very beginning of the infection.

Septic Endometritis. The close anatomical relationships existing between the mucosa of the puerperal uterus and the general circulation, through the uterine sinuses at the placental site, and through the spermatic, the uterine and the hypogastric veins, favor greatly a rapid spreading of an infection from the endometrium to the rest of the body. The defense mechanism against the extension of the infection from the endometrium has been studied extensively by Bumm, who described a granulation or rather a leucocytic zone between the superficial necrotic bacteria-laden layers of the endometrium and the deeper, healthy tissues. This anatomicopathologic concept continues to sway our understanding of septic endometritis. The infected postabortive or postpartum uterus is considered as forbidden ground, which no surgeon may enter manually or instrumentally, for the removal of the infected endometrium, except for the control of profuse bleeding. The fear of disturbing the zone of Bumm has possessed us to such a degree, that even vaginal examinations of febrile puerpera are proscribed in most clinics. Conservatism has been the therapeutic keynote of septic endometritis for the past twenty years, consisting mainly of sustaining diets, saline infusions, blood transfusions, foreign protein injections, antitoxins, sera and vaccines of questionable value, bacteriocides, and hope, chiefly hope. Under this form of polytherapy the morbidity and mortality curves of septic endometritis maintain their high level undisturbed, to our great chagrin; and yet the surgical removal of the septic focus, the infected endometrium by curettage, is anathema; why?

Because we dread the breaking through of Bumm's protecting leucocytic zone. But when we are confronted with the studies of Fromme, Warnekros and Schottmüller, who have shown that in the supposedly limited infection, bacteria were found beyond this leucocytic wall, in the healthy tissues, its protective importance ceases to be as valid an argument against the surgical invasion of the septic endometrium, as is generally ascribed to it. I have already indicated that saprophytes may assume parasitic roles, and at this juncture it is pertinent to ask the conservatives, what security they have that the bacteria of the endometrium may not suddenly change their virulency and penetrability, if allowed to stay long enough in the uterus? We may also ask, is the leucocytic zone of Bumm a specific defense mechanism of the uterus, and if not, why not apply the surgical rules governing the treatment of infections anywhere else to the endometrium as well? The surgeons in the late war learned an invaluable lesson, that the chances of the wounded to recover from shock and infection were much greater when the wounds were cleansed of every freshly crushed tissue, or of all the dead and dying tissue. Is the septic endometrium not an infected wound? Then why not clean the uterine interior of its dead, necrotic and bacteria-laden tissue?

We must learn once and for all that the danger of a bacterial infection does not lurk in the laboratory determination of the bacterial virulence alone, nor in the penetrability, nor in the single mechanical forcing of bacteria into the circulation, associated with a pelvic examination or the curetting of an infected uterus, but with

the repeated entry of the pathogenic bacteria from the septic focus into the blood stream. *To avoid the repeated entry of bacteria into the blood stream from the septic focus should be our prime function in the treatment of bacterial infection.*

Schottmüller followed this principle unswervingly. Seven thousand cases of septic endometritis, bacteriologically proved, were treated in his hospital by curettage, and the mortality did not exceed 0.35 per cent. These facts require no elucidation.

There are a few simple rules that ought to be observed in the surgical treatment of septic endometritis. The cervix must be sufficiently open to admit the curette or a ring clamp. If this condition is not present, it is better to wait another day, rather than resort to forcible dilatation. During the days of my initiatory training, septic endometritis was treated by curettment, i.e., the digital emptying of the uterus of its septic contents. By such manipulations, it was claimed that the least amount of trauma occurred to the endometrium, and therefore, the least amount of bacteria was forced into the circulation. I was never convinced of the gentleness of such a procedure, and have never employed it. Schottmüller is of the same opinion, and is convinced that the instrumental method, under the strictest aseptic precautions, and in good light, is the safest and least harmful. Uterine packing after a curettage for septic endometritis, or for retained secundines, should be abandoned. To rely upon the uterine pack to control bleeding after an incomplete abortion indicates poor technique. I have been convinced repeatedly that an empty uterus does not bleed, and that a bleeding uterus is not empty. The exceptions to the rule are: inertia uteri following hydramnios, twin pregnancy, prolonged labor, or hydatid mole; in all other conditions a proper emptying of the uterus will stop the bleeding. The contention that the pack favors uterine contraction, and shuts off the uterine sinuses and lymph spaces, thereby preventing the extension of the infection, is highly problematical. Furthermore, what will prevent the uterine contractions elicited mechanically or by drugs from forcing bacteria inward as well as outward towards the uterine interior? I very rarely resort to uterine packing.

Parametrial Lymphangitis or Pelvic Cellulitis. Parametrial lymphangitis following labor or abortion is caused in 88 per cent of the cases by the streptococcus hemolyticus. According to DeLee, Mauriceau in 1760 described for the first time the inflammation of the pelvic connective tissue; and Valpeau associated this lesion with the genital organs, which was substantiated by Doherty in 1843.

Our present knowledge of the pathology of pelvic cellulitis is that it is similar to a lymphangitis in any other part of the body. DeLee, following v. Rosthorn, rendered the following description of the different routes along which a parametritis may travel: (1) Lateral horizontal exudates spread along the bases of the broad ligaments, with a tendency to extend to lateral pelvic walls and around the cervix; the infection usually starts from cervical tears. (2) High intraligamentous infiltrations begin in the endometrium near the cornua uteri, and form tumors rounded above, with a tendency to unfold the broad ligament and climb up into the iliac fossae. (3) Exudates in the retrocervical connective tissue may spread either posteriorly along the uterosacral ligaments or sink into the rectovaginal septum. (4) Exudates in the precervical tissue spread towards its sides, and around the ureters. (5) Exudates anterior to the bladder spread behind the pubis, and may extend behind the recti muscles, even to the navel—"plastron abdominal" of the French. Several of these forms may be combined.

Pelvic cellulitis may run an acute course and terminate fatally in 50 per cent of the cases; it may become subacute and resolve; or it may form an abscess. When suppuration occurs, the abscess will usually point downwards into the vagina, but more often retroperitoneally, towards the hollow of

the sacrum, or above Poupart's ligament. At times it may also point towards the renal region.

The clinical course of a parametrial lymphangitis is very typical. As a rule on the second or third day, rarely later, after a delivery or abortion, there is a rise of temperature, initiated by a chill. The temperature may be continuous or intermittent, and of considerable elevation; it lasts from one or two weeks, subsides by lysis, and the patient recovers. If the cellulitis does not subside within this time, we must search for a suppurating focus.

It frequently becomes necessary to differentiate between a pelvic cellulitis and a salpingitis, and the following palpatory distinctions are of value. A pelvic lymphangitis (the most common type) begins to spread in a fan-like fashion, from the cervico-uterine junction outwards towards the lateral pelvic walls, causing the parametrial tissues to become indurated, and the uterus to be fixed in position. A salpingitis or a salpingo-oophoritis forms an irregular tumor; located higher up in the pelvis, it hugs the sides of the uterus and curves posteriorly to it, and there is always a groove between the tumor mass and the lateral pelvic wall. The adnexal mass moves with the uterus, and pain is elicited on moving the cervix. Positive blood cultures are rarely obtained in pelvic lymphangitis, because the path of invasion is more devious than in thrombophlebitis, but this negative finding does not imply that a lymphangitis is not a bacteriemia.

It is also worth noting that a salpingitis is almost never a septic focus, nor is a peritonitis to be considered as such. Schottmüller stresses the point that when a positive blood culture is obtained in a case of salpingitis or peritonitis, we must realize that the focus of infection is somewhere else, for they in themselves do not constitute it.

A postpartum salpingitis has proved to be in the majority of cases Neisserian in nature. It is seen most frequently in primiparae, in whom the infection did not cause a severe enough lesion in the tube to prevent conception and the carrying to term; but it works havoc after delivery, when the dormant infection flares up. This seals the tubes permanently and brings about the clinical entity of "one child sterility."

Peritonitis following a pelvic infection is invariably fatal; it is caused by the hemolytic streptococcus, or more frequently by the streptococcus putrificus. Early incision and free drainage of the peritoneal cavity is advisable, no matter how extensive the peritonitis may be.

Classical illustrations of the clinical course of acute, subacute and chronic types of pelvic cellulitis are furnished by the records of the following cases:

Case 1. L. S., aged twenty-six, admitted to the Beth Moses Hospital, on March 18, 1931, in labor at term. Examination: Cephalic presentation; L.O.A. position. Twelve hours after admission, delivery with low forceps, preceded by a prophylactic episiotomy. Two days after delivery, a chill with an elevation of temperature to 104°F.; W.B.C., 6100, polynuclears 86 per cent; mononuclears 14 per cent.

A vaginal examination on March 27 showed a gapping perineal wound, covered with necrotic and sloughing tissue. A tear in the right vaginal sulcus, extending from the introitus upwards for a distance of 3½ inches, and 1 inch in depth. The surrounding paravaginal tissues were indurated, and a purulent discharge trickled down from the upper vaginal tract. The cervix was torn on the left side, and there was a thickened, tender, left parametrium. The uterus was well involuted, not tender, and the adnexa normal to palpation. There were also a few red tender areas located respectively over the right forearm, the inner surface of the left ankle, and the posterior surface of the right chest wall. The perineal and the vaginal wounds were immediately cleansed and treated with mercurochrome applications daily. The blood count on March 30 showed a leucocytosis of 12,800; polynuclears 83 per cent; lymphocytes 17 per cent.

After the patient had run an intermittent temperature (Fig. 2) for eight days, the fever began to subside by lysis, and it reached normal at the end of the third week.

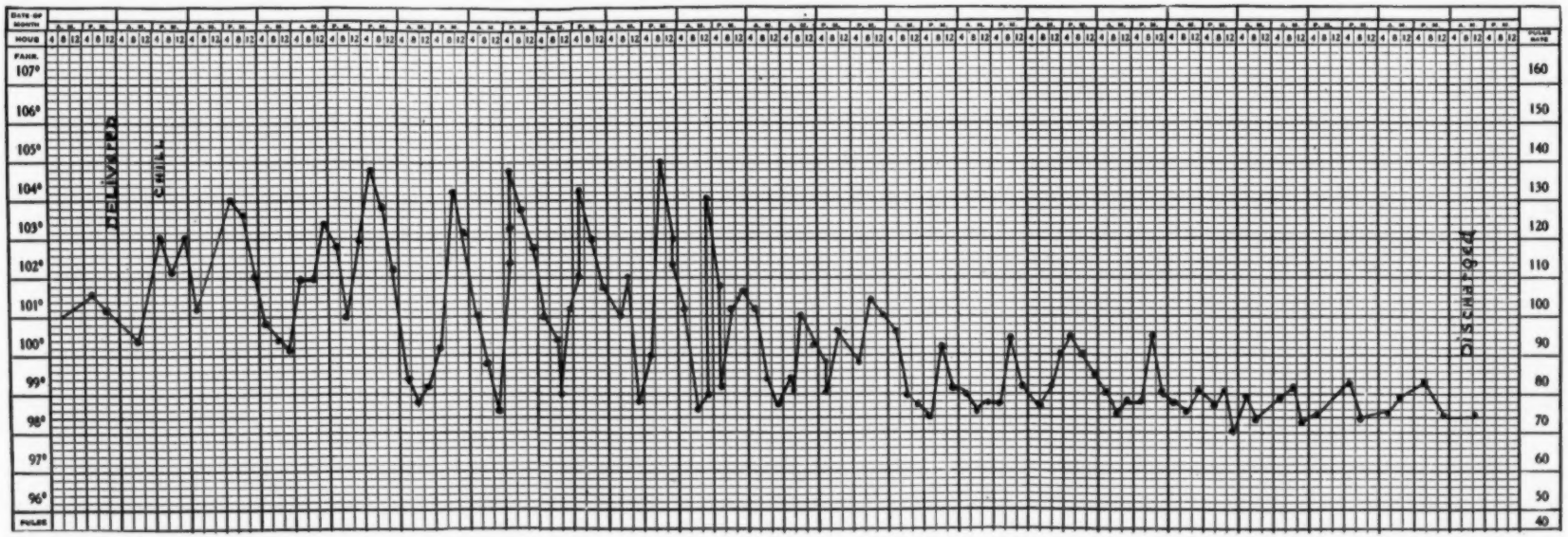

FIG. 2. Case 1. Acute pelvic lymphangitis. Primipara, delivered with low forceps. Prophylactic episiotomy. Chill twenty-four hours after delivery. On fourth day necrosis and sloughing of perineal incision and vaginal wounds, with paracolpitis and left parametritis.

Case II. M. K., aged thirty, gravida four, para two. Pregnancies and labors were normal. Menses were normal, the last period occurred on November 7, 1928. She was admitted to the Beth Moses Hospital on March 3, 1929, complaining of pain in the lower abdomen, uterine bleeding and expulsion of clots, for several days.

Physical examination: The abdomen was moderately distended, tender in the lower half, particularly in the right iliac fossa. There was moderate uterine bleeding, the cervix soft, external os open. On account of the abdominal rigidity, it was impossible to outline definitely the uterine body, but the clinical impression was that it was much larger than normally. The temperature was 100°F., pulse 88, respirations 24. A clinical diagnosis of an incomplete abortion with septic endometritis was made, and a curettage performed.

Twenty-four hours following the curettage, the temperature rose to 104.4°F., and it continued to run an irregular course for one week, after which it subsided by lysis to a level ranging between 99° and 101°F. This temperature curve continued for three weeks; then it rose again to higher levels, 103°F. in the evening, with a remission to below normal in the morning.

On April 23, a tumefaction was felt in the right lower quadrant of the abdomen (the same side of which the patient complained on admission). This mass extended obliquely upwards from the symphysis pubis along Poupart's ligament to a point opposite the anterior superior spine of the ilium, having a width of two fingers. The uterus and the adnexa were normal to palpation. The bases of the broad ligaments were soft and painless. A diagnosis of upper parametrial lymphangitis was made.

On April 24, an extraperitoneal incision was made in the right flank, parallel with Poupart's ligament, and the indurated area exposed. Aspiration failed to yield pus. A closer examination showed that this induration extended for quite a distance upwards, retroperitoneally, to the left of the incision, and that it could not be reached properly through this approach. A right rectus, transperitoneal incision was made, and on opening the peritoneal cavity it was found that the uterus, the adnexa and the broad ligaments looked and felt normal. The induration was retroperitoneal, behind the cecum and the ascending colon. The appendix was not involved; it was removed. Although no fluctuation was felt, the indurated area was incised, drains inserted and brought out at the lower angle of the incision.

On the following day a profuse purulent discharge appeared, the temperature subsided to a much lower level, not exceeding 101°F. for one week. Then the discharge diminished considerably, and the temperature rose correspondingly to its former height.

On June 14, the discharge from the wound increased again, but the temperature continued to run up to 103°F. daily, and the pain in the right lower quadrant grew worse steadily.

On July 12, I reopened the first incision, reinserted drains, and left the entire wound open. Within twenty-four hours a profuse purulent discharge reappeared, and for one more week the temperature continued intermittently, but then it subsided by lysis, and from September 9 until her discharge on September 23, it remained normal.

Comment. Although a curettage was performed on this patient soon after admission to the hospital, the progress of the infection was not stopped, because at that time the endometrium no longer constituted the sole septic focus, as was indicated by the tenderness and the pain to the right of the uterus. This important fact was overlooked by the clinician who attended the patient first. And while I am a follower of Schottmüller, who advocates curetting for septic endometritis, I am also careful of his admonition, "only when the endometrium alone forms the septic focus." The uterine bleeding in this particular case overshadowed the other clinical signs, and so the curettage may be condoned. What interests us particularly in this case is the surgical treatment of the pelvic lymphangitis according to surgical and not the commonly accepted gynecological or obstetrical procedures. As soon as I became convinced of the presence of the retroperitoneal lymphangitis, which ascended from the pelvis, most likely from the posterior paracervical connective tissue, I attacked this focus repeatedly, long before any fluctuation could be felt.

Cullen advocated such treatment fifteen years ago, yet few gynecologists have heeded his sane and sound postulate. Our leading obstetricians wait until these hard pelvic indurations soften and form abscesses, and only then do they incise and drain. But how many of these patients waste away and die before this softening occurs. The experiences of Douglas and Shelton are similar to my own. "Frequently after the indurated mass is incised only a small gush of serum follows. Drainage usually becomes more and more profuse in the course of a day or two, and the condition of the patient improves markedly." Williams stated that "incision into the broad ligament cellulitis, with evacuation of only small amounts of serum, frequently gives as good results as if large amounts of pus were encountered, which is true of cellulitis in general." I trust that by the repetition of these known truths a more universal application of this form of treating pelvic cellulitis will follow. The correctness of the transperitoneal approach may be questioned justly, but in this case it was the only avenue of access. This, as well as many other experiences which come to my mind at the present writing, convinces me that the danger of a general peritonitis following a transperitoneal approach to a septic focus is over-exaggerated. This complication can be lessened greatly by ample drainage and gentle manipulation of the intra-abdominal contents. I am also convinced that the gain in shortened morbidities and lower mortalities resulting from early incision and drainage of hard parametrial exudates exceeds by far the benefits accruing from watchful waiting for absorption or abscess formation.

Lymphangitis of the Myometrium (Septic Myometritis) and Myometrial Abscess. A lymphangitis of the myometrium differs pathologically from a lymphangitis in any other tissue only in so far as the pus-laden lymphatics and veins lie in a muscular instead of a connective-tissue stroma. The infection spreads from the endometrium to the uterine wall, along the lymph spaces and veins, and forms multiple minute, or fewer larger abscesses, resembling a carbuncle. Septic endometritis in a uterus, the seat of interstitial and submucous myomata, favors the development of large uterine wall abscesses. I have had the unusual opportunity of obtaining specimens depicting each of these pathological phenomena operatively instead of post mortem, and fortunately each of my patients recovered.

Case III. I. B., aged forty-seven, para ix, was admitted to Beth Moses Hospital on September 5, 1931, two weeks after her last normal delivery. She complained of chills and fever of one week's duration, foul-smelling vaginal discharge, and pains in the back and lower abdomen.

Physical Examination. Face anxious, tongue dry and septic in appearance, lips cyanotic, mentality clear. Lungs and heart negative. Temperature 103.2°F.; pulse 140; blood pressure 195/124; R.B.C. 4,000,000; W.B.C. 5600; polynuclears 79 per cent; sedimentation rate forty-five minutes; hemoglobin 84 per cent; urine negative.

Vaginal: There was a slight dark serosanguinous discharge, moderate relaxation of the vaginal outlet. The cervix was eroded and lacerated, the external os patulous. There was no pain on moving cervix. The uterus was involuted, somewhat tender. Left adnexa were normal, right adnexa thickened. Abdominal: a hard tender tumor mass occupied the right lower quadrant. The lower extremities showed marked varicosities. The clinical impression was right adnexal inflammation.

From the day of admission to the time of operation (eleven days) she ran an intermittent febrile course (Fig. 3) with chills, the temperature mounting from time to time to 105° and 106°F. Two blood cultures taken soon after the chills were negative. The blood picture during this time varied but little, except that the white blood cells increased from 5600 on the day of admission to 14,000 on two subsequent occasions. The sedimentation rate did not go below forty minutes at any given time. The treatment consisted of watchful waiting and three indirect blood transfusions of 250 to 300 c.c. on the 6th, the 9th and the 15th of September, respectively.

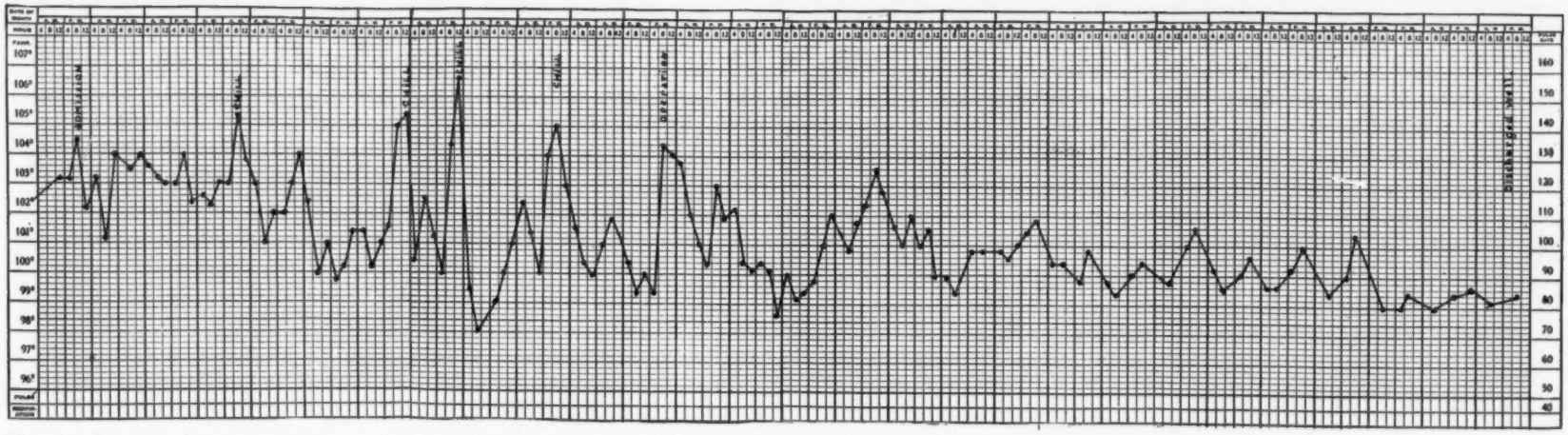

FIG. 3. Case III. Acute septic myometritis with diffuse myometrial abscesses. Aged forty-seven, para xi, last full term pregnancy, spontaneous delivery, two weeks before admission to hospital. Chills and fever of one week's duration.

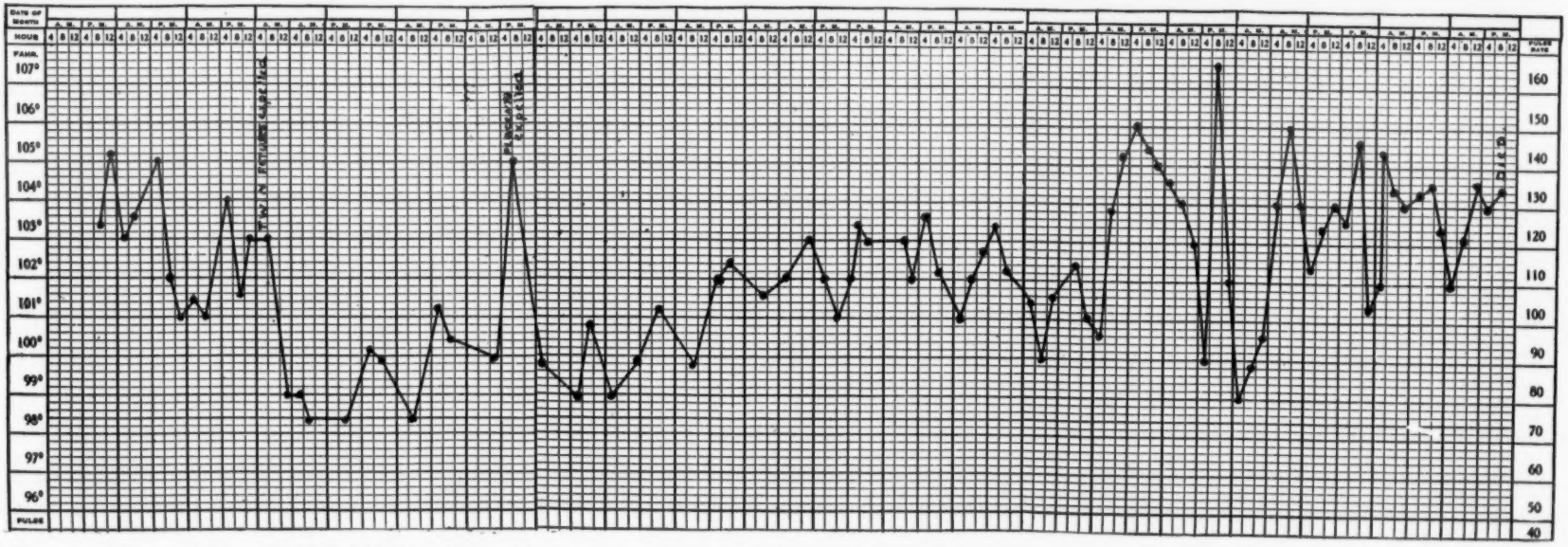

FIG. 4. Case v. Acute thrombophlebitis. Aged thirty-four, multipara. One week before admission to hospital had abortion induced. Treated conservatively. Died at end of fourth week.

On September 14 I saw the patient for the first time. My findings were: Abdominal: an irregular mass extended from a point three fingers' breadth below the umbilicus into the pelvis, and laterally to the outer borders of the recti muscles. There was marked tenderness over the right half of this tumor. Vaginal: The outlet was relaxed and there was a profuse mucopurulent odorless discharge. The cervix was high in position, with a stellate laceration; the external os wide open. The uterus was enlarged, corresponding in size to a gestation of three months, of a doughy consistency, irregular in outline on the right, where it merged with another partly cystic and partly solid mass which bent downwards into the pelvis and posterior to it. The cul-de-sac of Douglas was free. The left adnexa and left parametria were normal.

A diagnosis of septic metritis involving the right adnexa was made, and a hysterectomy advised.

Operation. On September 16, 1931, I performed a supracervical hysterectomy and a bilateral salpingo-oophorectomy, with vaginal and abdominal drainage.

Operative Findings. The uterus was irregularly enlarged, the size of a three months' pregnancy, slightly adherent to the upper part of the posterior pelvic wall, and deviated somewhat to the left. The right half of the uterus looked larger than the left and was of a boggy ligneous consistency. The left adnexa were normal. The right ovary, the size of a lemon, was adherent to the posterior aspect of the broad ligament and side of the uterus. The fallopian tube, as thick as the index finger, was edematous and lay in the upper part of the broad ligament. The round ligament was of a similar thickness and consistency, and was riddled with many small abscesses.

Fig. 5. Case III. Acute endometritis, excessive infiltration of lymphatics with mononuclear and polynuclear leucocytes; at (A) a superficial abscess, overlying epithelium destroyed; blood vessels show intimal and medial thickening, and thrombosis of many veins.

Microscopic Findings. The infection could be traced from the uterine mucosa (Fig. 5), along the lymph spaces in the uterine wall (Fig. 6), where it formed many abscesses. The blood vessel congestion was marked, the walls of the larger blood vessels presenting intimal and medial thickening, and fragmentation of the elastic lamellae and fibers. Many veins were thrombosed and congested. In some of the blood vessels the thrombi were invaded by fibroblasts from the vessel wall and were

organized, all of which established the microscopic diagnosis of acute suppurative metritis.

Postoperative Course. Figure 3 furnishes a striking, graphic example of how quickly a bacterial infection will improve if the septic focus is removed in time. Immediately after the operation the temperature began to subside, and only once, on the fourth postoperative day, did it rise again to 103.6°F. The chills did not recur, and the progress to recovery continued uninterruptedly.

Fig. 6. Case III. Acute myometritis, lymph spaces filled with pus cells. At (A) one of numerous abscesses which riddled uterine walls particularly on right side.

An abscess of the uterine wall is nothing more nor less than a localized pus formation in the myometrium, which may occur in the process of a myometrial lymphangitis. According to v. Franque this is a rare pathological condition. These abscesses may be single or multiple, and of various sizes. V. Franque collected 7 cases from the older literature, and Risch, 22 cases from more recent records. Halban and Koehler report 7 cases, which constituted 4.29 per cent of their material. Considering more closely the pathology of metritis dessicans and that of metritic abscess, we may say that in many, or in most instances, purulent gangrenous metritis or metritis dessicans is the forerunner of a uterine wall abscess.

The diagnosis of a uterine abscess is difficult; in all the cases reported the diagnosis was established either post mortem or post operationem. If, however, on careful bimanual palpation the parametria and the adnexa are normal, and the uterus shows a localized tender area, the diagnosis of an abscess in the uterine wall may be made with justifiable certainty, and a hysterectomy restored to as the only curative procedure.

Case IV. F. D., aged thirty-six, nullipara, came under my care on June 25, 1925, stating that eight weeks before she had miscarried spontaneously in the third month of pregnancy, and had been curetted at the New York Hospital. Since then she had been confined to bed, complaining of pain in the lower abdomen, weakness and daily remissions of temperature ranging from 100° to 103°F.

A bimanual examination disclosed an irregularly enlarged uterus, corresponding in size to

a pregnancy of ten weeks, the seat of several interstitial and subserous myomata. The right side of the uterus was very tender. Parametria and adnexa were negative to palpation. A diagnosis of necrosis and suppuration of one of the myomata was made, and a hysterectomy advised.

On June 26, 1925, I performed a supracervical hysterectomy at the Hospital for Joint Diseases. The operative findings were: An irregularly shaped uterus, measuring 13 × 12 × 7 cm., containing interstitial myomata. On section, the endometrium showed a marked hyperplasia, covered with a purulent exudate. Projecting from the fundal portion of the uterus was a partly submucous myoma, in a state of necrosis and suppuration. A similar condition existed in an interstitial myoma of the right uterine wall. Smears taken from the endometrium yielded a gram-positive short-chained streptococcus, and some gram-positive bacilli. The adnexa were normal.

On the day following the operation the temperature subsided to normal, and remained at this level until the discharge of the patient at the end of fourteen days.

Septic Thrombophlebitis or Endophlebitis. Puerperal infections by way of the venous channels are six times as frequent as those via the lymphatics. The course of its dissemination begins in the venous plexuses formed by the radicals of the ovarian, the uterine and the hypogastric veins, of one or both sides.

In every venous thrombosis, the result of a bacterial infection, there is an associated phlebitis and paraphlebitis which is a local defense reaction against the bacterial invasion. Pathological studies have shown repeatedly that there are no pure cases of thrombophlebitis without an accompanying lymphangitis of the perivascular lymph spaces; and vice versa, there is no case of pure lymphangitis without an associated phlebitis. This pathological fact, to which little attention is given in the treatment of septic thrombophlebitis, is responsible for the therapeutic failures of ligation of the infected veins. The difference between a general sepsis and a thrombophlebitis is one of degree only, conditioned by the variation in the rate at which bacteria are discharged into the blood stream from the septic focus. In the fulminant types of thrombophlebitis, the bacterial invasion is so rapid that at autopsy no evidences of a protective reaction in the septically damaged organs are found. In pyemia, the blood stream inundations are intermittent, and the bacteria are carried by emboli or particles that have crumbled off from the infected thrombus. The most common pathogenic organisms that give rise to thrombophlebitis are in order of frequency, the staphylococcus and the streptococcus hemolyticus.

The early clinical diagnosis of pelvic thrombophlebitis by palpation is exceedingly difficult, and it is during the early stages of its development that the diagnosis is most valuable for surgical treatment. The other pathognomonic signs and symptoms of endophlebitis are: repeated chills, exhaustion and steep rises of temperature followed by drops to normal or below. Between chills the patient feels well and asks to leave her bed. This temporary euphoria is soon interrupted by another chill and a repetition of the cycle. According to Mahler we may suspect a thrombophlebitis when there is an acceleration of the pulse rate in the presence of a normal temperature, or a sustained, rapid pulse with a dropping temperature. Michaelis' sign of thrombophlebitis is an unexplainable subnormal temperature in postpartum or postoperative cases. Of the laboratory aids in the diagnosis of a septic thrombophlebitis, Stoeckel takes the following into consideration: (a) A laevodeviation of the blood picture; (b) a deficiency in eosinophiles; (c) a rapid sedimentation of the erythrocytes; (d) a reduction in hemoglobin; and (e) a thrombocytopenia.

The prognosis of thrombophlebitis, as already indicated, is very grave. From 90 to 95 per cent of the patients die of the disease. The acute form terminates in death within two weeks after the onset, and the subacute type may linger from one

to two months. The severity of the disease is determined by the multiplicity of its secondary foci, which involve the lungs, the kidneys, the spleen, the muscles and the joints.

Schottmüller called our attention to the fact "that in 10 per cent of the cases of pelvic thrombophlebitis, the primary focus may undergo a spontaneous obliteration, and if this occurs the secondary focus or foci may also heal." This observation substantiates once more the rationality of the surgical treatment of puerperal sepsis, and justifies the removal of the primary focus even in the presence of surgically inaccessible secondary foci. It also gives rise to the thought that there is after all some biological similarity between the spread of bacterial infections and malignant metastases; for gynecologists have repeatedly observed that occasionally, after removing a primary ovarian papillary adenocarcinoma, the unremovable metastases will undergo involution and obliteration. In tuberculosis, the opposite has been learned, that the removal of a secondary focus may affect the primary source favorably. All of these facts lead to one supreme conclusion, that the smaller the number of invading pathogenic bacteria from the septic focus, or the lesser the metastases from the primary growth, the more successfully may the natural defense mechanism of the body, and the artificial aids employed, stem the tide of sepsis and the extension of the malignancy.

A bacteriologic study of the offending microorganisms in septic thrombophlebitis is of limited prognostic value. In the majority of cases, the anaerobic streptococcus putrificus is the offending agent, and yet as recently as 1925, Zweifel considered this bacterium harmless. In Schottmüller's vast experience, the favorable cases of septic thrombophlebitis were those whose blood cultures yielded an anaerobic diphtheroid rod-like bacillus. In view of this contradiction we must revert again to Schottmüller's dictum, that the type of bacterium causing an infection does not by itself determine its course and outcome, but rather the location of the septic focus, the depth, extent and frequency of the bacterial invasion.

A careful study of the temperature curves in septic thrombophlebitis is of prognostic value. If the temperature does not subside sufficiently between chills, but remains at a fairly high level, it indicates a low resistance, or a high virulence, or both. If this state continues, the thrombophlebitis changes into a general infection with multiple secondary foci.

Another important factor which governs and influences the outcome of a septic thrombophlebitis is the local phlebitis and periphlebitis. If the inflammatory reaction in the wall of the vein surrounding the thrombus, and in the adjacent tissues, succeeds in encapsulating and organizing the thrombus early in the course of the disease, a cure may follow; but if the thrombus grows at a more rapid rate than the reacting inflammation, the septic infection will gain the upper hand. It is due to this failure of a local defense reaction in the wall of the infected vein that our attempts to treat thrombophlebitis by ligation have failed, for the infection has already spread far beyond the confines of the thrombus which we seek to isolate. But even in cases in which the local reaction is favorable, ligation fails at times to prevent the extension of the infection. Why? Because the tying off of the thrombosed vein excludes the focus of infection only in so far as the carrying of emboli from the crumbling thrombus is concerned, but it does not prevent the escape of bacteria from the walls of the ligated portion of the vein into the surrounding lymphatics.

Case v. M. F., colored, aged thirty-four, married, para three, no miscarriages. Menses were normal, the last period occurring on October 28, 1929. She was admitted to Beth Moses Hospital February 21, 1930, with a temperature of 103.4°F., pulse 130, respirations 24, complaining of chills, fever and vaginal bleeding for several days.

Examination. The abdomen was tense, and showed scars of previous operations for appendicitis and double inguinal herniae. The uterus was the size of a four months' gestation. The cervix was soft; the external os admitted the tip of the index finger, and the fetal parts were easily felt. There was moderate uterine bleeding. The parametria were soft and not tender. Blood count: R.B.C., 3,296,000; W.B.C., 8,900; polynuclears, 89 per cent; lymphocytes, 11 per cent; sedimentation time thirty-two minutes.

Diagnosis. Unavoidable miscarriage and septic endometritis.

Treatment. The cervix and vagina were packed with iodoform gauze, and castor oil and quinine given. The following morning the patient felt better, and the temperature subsided to 101.2°F., pulse 136, moderate vaginal bleeding. The packing was removed, the cervix showed more dilatation, but the products of conception were still in situ. The cervix and vagina were repacked with iodinized gauze, and more quinine and castor oil administered. At 11.40 P.M. twin fetuses were expelled, but not the placenta, and there was slight bleeding.

On February 24, the temperature dropped to 99°F., the pulse to 118, and the general condition of the patient was much better; but as the uterine bleeding continued, the vagina was packed once more. On the morning of February 26 the temperature rose to 101.2°F., the vaginal packing was removed, but the placenta was still in the uterus, and moderate bleeding still continued. On February 28, she had a severe chill, the temperature rose to 105°F., the placenta was expelled spontaneously, followed by a drop in the temperature to 101°F., at which level it stayed for two days. From then on the temperature curves varied from 101° to 104°F. for one week. At this time the vaginal discharge became greenish yellow and foul. On March 3, a direct transfusion of 500 c.c. of blood was given. On March 6, a thrombosis of the right popliteal vein developed. On March 8, the temperature rose to 106.2°F., and it continued to rise daily to this level and higher, with remissions of 6 to 7 degrees (Fig. 4), accompanied by chills. On March 10 the right leg became swollen to twice its normal size, with tenderness over the left femoral vein. On March 13, at the end of the third week of her illness, she died.

Autopsy Findings. There was gangrenous necrotizing endometritis and myometritis with multiple abscesses in the uterine wall, the tubes and ovaries; acute fibrinopurulent peritonitis; pyelophlebitis of both ovarian veins with multiple septic thrombi; multiple septic infarcts in the lungs and the spleen; bilateral fibrinopurulent pleuritis; myocardial degeneration and cloudy swelling of both kidneys.

Comment. The prevailing principle of "nolle me tangere," followed religiously in most clinics in the treatment of septic abortions or miscarriages, was carried out to the letter in this case (without my knowledge). The uterus was not invaded instrumentally or manually. The emptying of the uterine contents was assisted by repeated vaginal and partly cervical packing, and by oxytocic drugs. After the expulsion of the fetuses, the retained placenta was permitted to remain in situ (for the bleeding was slight) for nearly five days, until it was expelled spontaneously. In spite of all this ultraconservatism, the patient died of a fulminant thrombophlebitis. Immediate emptying of the uterus, followed by an early ligation of the hypogastric veins might have saved this patient.

Ligation of the pelvic veins for septic thrombophlebitis is undoubtedly a most radical and rational procedure. Sippel, in 1894, was the first one to suggest it. A. W. Freund, in 1896, performed the first ligation and excision of thrombosed pelvic veins, following a hysterectomy for puerperal sepsis. Bumm reported 3 cases of ligation and resection of the spermatic veins for endophlebitis; all of his patients died. Baldwin has operated upon 90 cases of puerperal thrombophlebitis since 1914 with a mortality of 25.5 per cent. Many of his operations included hysterectomies. Hiram Vineberg is to my knowledge one of the earliest American gynecologists who advocated and practiced radical surgical conservatism in the treatment of puerperal thrombophlebitis, and other forms of puerperal sepsis. Quite recently Martens of Berlin, quoted by Stoeckel, reported excellent results with early ligation of the pelvic veins; and Stoeckel, who has operated on a con-

siderable number of patients with pelvic thrombophlebitis transperitoneally, is now adopting the extraperitoneal approach as advocated by Martens. This method was first suggested by Trendelenburg.

Acute Septic Endocarditis. When the endocardium becomes the septic focus in the course of a puerperal infection, the mortality reaches 100 per cent. Schottmüller found the staphylococcus aureus as the offending microorganism in 61 per cent of the cases; the streptococcus hemolyticus pyogenes in 25 per cent, and the anaerobic streptococcus and the pneumococcus only rarely.

Clinically, acute septic endocarditis is characterized by a high fever, which continues to the very end of the disease, and the fatal termination sets in usually within one to two weeks after the beginning of the illness. Due to the short duration of this disease, organic murmurs appear but seldom, but the so-called hemic murmurs are present. In the absence of cardiac symptoms, an acute septic endocarditis can still be diagnosed by the ever-present bacteria in the blood in such profusion as is seldom encountered in any other form of sepsis. We must always think of an acute septic endocarditis when, in the presence of a continuous bacteriemia, no other septic focus can be located.

CONCLUSIONS

1. Pathogenic bacteria do not multiply in the blood stream of human beings (except in the most fulminant types, or as an antemortem phenomenon), but in the septic focus, from which they are discharged into the lymph and blood streams, in larger or smaller quantities, and at longer or shorter intervals, according to the direct or the indirect anatomical relation between the septic focus and the circulation.

2. The course and outcome of a bacterial infection are determined far more conclusively by the location of the septic focus and by the depth and extent of the bacterial invasion, than by the type of the pathogenic microorganism causing it.

3. Every bacterial infection is associated with a greater or lesser invasion of the blood stream; therefore, every puerperal infection is a bacteriemia of varying degrees of severity.

4. A single entry of pathogenic bacteria into the blood stream does not constitute a severe or a fatal sepsis.

5. The failure to recover bacteria from the blood in outspoken cases of bacteriemia is due to two factors: (a) the abstraction of the blood during or immediately after the chill, instead of from three to five hours before its occurrence, and (b) the neglect of making anaerobic cultures as well as aerobic.

6. The septic focus forms the integral part of every bacterial infection, and its removal or deviation from the blood stream constitutes the only effective remedy in the treatment of puerperal sepsis. The only contraindication of this procedure is inaccessibility, or its location within an organ whose removal may cause immediate death.

7. Septic endometritis should be treated by curettage as long as the septic focus is limited to the endometrium, and septic myometritis, by hysterectomy; pelvic thrombophlebitis, by early ligation of the effected vessels, and excision of the ligated part, with or without a hysterectomy, depending upon the condition of the uterus. Pelvic cellulitis should be incised early, as soon as the induration becomes accessible, and not wait for fluctuation. The best avenue of approach is the extraperitoneal, suprapubic or lateral, depending upon the location of the induration. Lateral vaginal incisions should be avoided on account of the danger of injuring the ureter or the uterine artery.

8. The sooner the gynecologists and obstetricians adopt the principles which govern the treatment of bacterial infections in general surgery, the sooner will the morbidity and the mortality of the infected puerpera be reduced.

[For References see p. 152.]

SMALL STRANGULATED CYST OF THE UMBILICUS

NECESSITATING OPERATION; ASSOCIATED FINDINGS OF ADENOMYOMA

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IN the case presented below we were apparently dealing primarily with a major surgical problem; either a strangulated umbilical hernia or an incarcerated omentum in a hernial sac. Operation disclosed to our surprise a small strangulated umbilical cyst. What was its origin? Was it omphalomesenteric, urachus, dermoid, angioma, lymphocele or what? Careful dissection, histological studies, revealing an associated adenomyoma, and a survey of the literature served to clear our impressions as to the exact nature of the lesion. Being neither of omphalomesenteric or urachal origin and certainly not a dermoid, angioma or lymphocele, we apparently had in hand a unique, extremely rare condition: a complex cyst originating in some way either from a nipped off preformed hernial sac or from persisting remnants of the exocelome.

CASE REPORT

History: L. S., married, was twenty-five years of age when first seen in the Howard A. Kelly Hospital in 1914, complaining of sterility, painful menstruation and troublesome hemorrhoids. Pelvic examination revealed no anatomical variations responsible for the dysmenorrhea or sterility and so the patient, who had been married but a short time, was sent home with instructions to return in six months should she not conceive in the interval.

Thirteen years later, in 1927, she returned, still nulliparous, with a symptomless myomatous uterus felt well above the symphysis.

The first note on the umbilicus was on June 17, 1929, when, the record states, "Patient complains of a little pain in the naval." From the onset of this peculiar umbilical tenderness up to December, 1929, the pain was intermittent, with intervals of quiescence as long as a month, but with an average recurrence every fortnight. At no time did the severity preclude household duties until the final attack. At the beginning she experienced a slight sensation of tenderness in the umbilicus, annoying her for two or three hours. Since December, 1929, this had become distressing, lasting for two or three days and recurring every seven to ten days.

It may be added that never had there been any history of a discharge from the umbilicus. Abdominal colic had never been observed nor had there been any swelling or discoloration of the umbilicus at the time of menstruation.

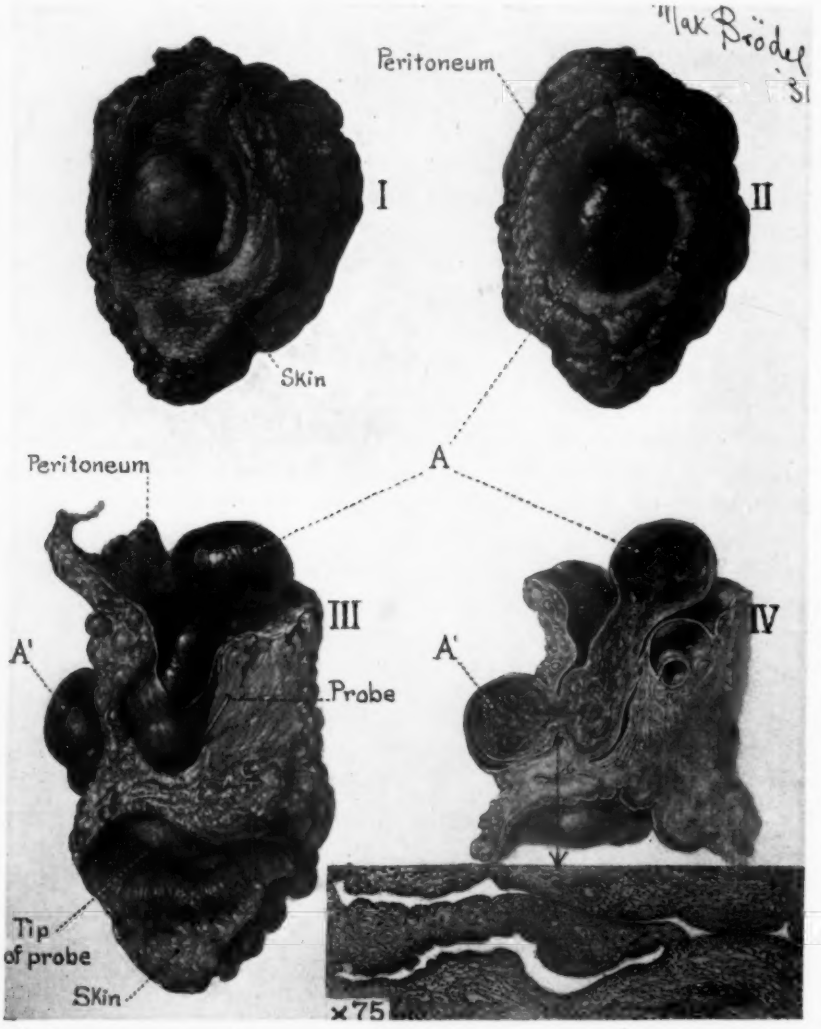
On October 4, 1930, the usual umbilical tenderness set in and became progressively worse until she appeared for examination. Doctor Kelly felt a small irreducible nodule which had escaped her notice in the upper left quadrant of the umbilicus and diagnosed an umbilical hernia and explained that sooner or later this condition would possibly become more troublesome, probably necessitating operation. On October 13 she was admitted to the hospital, saying that the lump gradually grew larger, became tense and blue. Constant excruciating pain prevented sleep and was particularly aggravated by walking. There had been no nausea, no colicky cramps, no unusual constipation, no blood in the stool, nothing in fact to suggest a partial obstruction.

Physical Examination: Well-nourished, apparent age about forty, lying abed with an expression of protracted pain. General findings essentially negative. Abdomen soft, no antiperistaltic waves seen. In upper left quadrant of the umbilicus there is an extremely tense, exquisitely painful, round, bluish nodule, about 1 cm. in diameter (see Fig. 1), covered with smooth, shiny, thinned-out skin. There is no fluctuation but it is slightly compressible; pain checks efforts at reduction.

A diagnosis was made of (1) strangulated umbilical hernia, or (2) incarcerated omentum in a preformed hernial sac.

Operative Note: Excision of umbilical cyst by Dr. Kelly with electrosurgery making a transverse elliptical skin incision, 4 × 2 cm.,

including the umbilicus. Dissection through the fat, fascia and peritoneum. The umbilicus in this way removed in toto, with a small tumor dome-shaped, covered by skin, with a sessile base, the dermal covering of the little tumor thinned out and under considerable tension:



Figs. 1 and 2. Umbilical cyst as removed at operation showing dermal and peritoneal aspects. Note tiny peritoneal cyst to right, Fig. 2.

Fig. 3. Lateral view dissected out, umbilical ring widely open showing constricted neck, dumb-bell cyst and reflected peritoneum which continues intimately over A'. Serous space in which probe lies originally contained A' as shown displaced to left.

Fig. 4. Cross section of Figure 3 with inset of adenomyoma from point indicated. Note small peritoneal cyst to right, within which is a secondary or "daughter" cyst. A' through this cut was solid: its two distinct coverings are clearly pictured.

bulging into it and out through the peritoneal ring, appearing to be a urachal cyst. No hernial sac nor any omentum or intestine adherent anywhere. Closure by transverse sutures. Following this hemorrhoidectomy. The symptomless uterine fibroid was left.

Gross Pathology Report: An elliptical piece of abdominal wall, 2.5 cm. in thickness, incorporated with the umbilicus. In one quadrant of the umbilicus is a tumor nodule, roughly it has the bluish color of an adenomyoma. It feels cystic. (See Fig. 1.)

A somewhat similar nodule covered with glistening, but not translucent, peritoneum protrudes on the peritoneal aspect: for clearness this will be called the "peritoneal bulb" (A, Figs. 2, 3, 4). It is reddish purple in color, 1 cm. in diameter, and broadly and loosely attached to the peritoneum from which it is readily separated. On separation the peritoneal

bulb is found narrowing down to a neck constricted by a fibrous peritoneal ring 4 mm. in diameter, and resembles a grape hanging by a stem from the umbilical ring.

Further dissection is difficult and despite painstaking precaution not to perforate the peritoneal bulb a sudden ooze of clear straw-colored fluid discloses a second collapsed thin walled sac the size of a pea, as seen in Figure 4. This is considered of peritoneal origin as is also the tiny cyst seen on the right in Figure 2. As the dissection through fascia and subcutaneous fat is continued the constricted neck is seen to expand into the tense sac pouting out under the skin and forming the umbilical nodule (A′, Figs. 3 and 4; Fig. 3 was drawn after A′ had been displaced in the handling from its original bed in which the probe lies).

We have then a dumb-bell cyst: one pouch (filled with firm blood clot) hangs from the peritoneal ring by a stem which passes through the abdominal fascia and fat to distend into the tense sac (filled partly with firm clot and partly with clear fluid) of the umbilicus.

Figure 3 shows clearly the peritoneal reflection encasing the intramural part of the cyst. This reflection is firmly fused to the cyst neck at the umbilical ring. Passing up from the ring it is easily followed and freed except in places; this is particularly true immediately beneath the skin where it adheres inseparably to the cyst wall proper and outlying subcutaneous tissue. Pocketed between the cyst and its peritoneal covering is a layer of pent up serous fluid.

The probe (Fig. 3) lies in a second fluid compartment which separates the outlying fat from the peritoneal reflection. This separation is by no means complete for strands of fibrous tissue here and there span the space and immediately under the skin there is an inseparable fusion of all tissues including from within, out, cyst wall, peritoneal reflection, subcutaneous fat with its glistening lining. The inner lining of this second space (probe) is the well-defined peritoneal reflection (just described) while its outer lining is a second smooth membrane with supporting fat as a base. This extreme outer lining also begins in the thickened peritoneum about the ring, and likewise might be considered of peritoneal origin.

Microscopic Examination: The peritoneal bulb is made up of organizing blood clot with peripheral vacuolization, fibrolasts, some giant cells, and macrophages filled with blood pigment. Here and there a thinned-out modified peritoneal-like lining is seen.

The same applies fairly well to the intramural bulb except that there is less blood, less organization, more loose fibrin and the outer lining is for the most part formed of cells ranging in height from flattened endothelium through compact spindle cells to two or more layers of loose cuboidal cells. Most of the sections have been so cut as to show well above the peritoneal ring (on one side only) a continuation of this same mixed cell lining up over the outlying fat. Lying free between these linings is the reflected peritoneum (Fig. 3) which histologically resembles a poorly epithelialized, extremely vascular, pleural adhesion.

The small peritoneal cyst just outside the ring is irregular in outline. The outer surface is normal peritoneum while its inner layer is composed largely of low cuboidal cells.

At a point as indicated in Figure 4 an epithelial glandular structure with quite characteristic endometrial stroma is seen, the whole strikingly like a patch of uterine mucosa. This is well represented in the accompanying inset. Within the gland lumen are blood pigment and macrophages indicative of old hemorrhage. While this is not a textbook picture of adenomyoma its appearance seems sufficiently suggestive for such an interpretation. No other sections were quite so typical of adenomyoma as the one pictured.

The subcutaneous tissue and contiguous fat present myriads of small round cells, many mononuclear wandering cells, some perivascular infiltration, much fibrosis with many irregular lymph spaces lined with flat and low cuboidal cells.

DISCUSSION

As to the exact origin of this anomaly one can do little more than theorize. The finding of what appears to be displaced endometrium bears no significant relationship to the nature or origin of the cyst proper; this is recorded to bring forward again the fact that displaced uterine mucosa or remnants of Muller's ducts is by no means so rare about the umbilicus as one might imagine (Dr. Cullen[1]). The

[1] Cullen, T. S. The Umbilicus and Its Diseases. Phila., Saunders, 1916.

presence of old blood within the gland lumen as well as intracystic hemorrhage gives room for the speculation as to an associated menstruation phenomenon.

The surrounding and contiguous tissue pictures are histologically well within the limits of chronic irritation and foreign body reactions.

Nothing is suggestive of dermoid, angioma or lymphocele.

We are assuredly not dealing with an omphalomes-enteric cyst. In the first place the contents of such are invariably thick and mucoid in character, and conclusive is the absence of the cylindrical intestinal epithelium always present, with Lieberkuhn's crypts which are fairly consistent features.

As to the urachus as the vestige of origin, the usual histological picture in this type of cyst is that of a cuboidal or transitional cell lining; if cuboidal the cells are usually in a single layer, also an outer fibrous coat is present incorporated with muscle fibers. The position of such cysts is invariably under the peritoneum in a line from the vertex of the bladder to the umbilical ring, most often in the lower third of this line. The situation of our cyst together with its outlying coverings are features which oppose urachal origin, although there is nothing to prevent an urachal cyst from developing in this site.

Having then disposed, by microscopical studies mainly, of the various possible sources from which this unusual tumor may have developed there still confronts us the task of sifting down evidence to put this cyst into its proper place. Considering the complex nature of the specimen, with its double peritoneal coverings, its associated adenomyoma, hemorrhage and tendency of the parietal peritoneum to form tiny cysts it would seem unwise to reach any positive conclusion as to its origin and development. Daughter cysts arising from a preformed hernial sac or from persistent exocelome would seem as plausible an explanation as any, but we are satisfied to classify it as a small umbilical cyst of undetermined origin.

I am indebted to Dr. T. S. Cullen and Mr. Max Broedel for the interest each has taken in this their special subject, umbilicus.

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[Continued on p. 156.]

*Continued from p. 148.

DIRECT APPLICATION OF THE ULTRAVIOLET RAY TO THE GENITOURINARY SYSTEM

PRELIMINARY REPORT*

SAMUEL LUBASH, M.D., F.A.C.S.

NEW YORK CITY

NOT unmindful of the fact that it is an innovation, we present a method whereby the ultraviolet ray can be applied directly to any part of the genitourinary system. For this very reason we should like at the outset to make it quite clear that we do not attempt to draw any conclusions at this time, but would rather allow the future to evaluate the benefits of this ray by the results that will be accumulated. The beneficial actinic ray has long been known and its application to the skin surfaces is almost ancient, yet not until quite recently has man attempted to introduce this agent within the body.

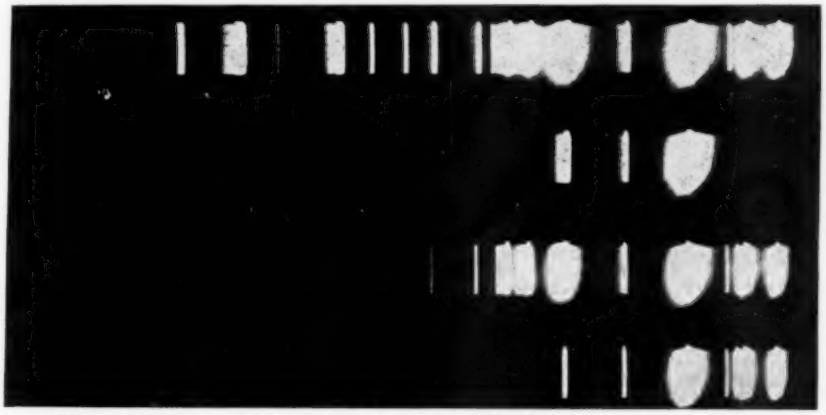

FIG. 1. Comparative spectra of quartz, blue filter, corex D, and glass.

This has been attempted in tuberculous cystitis by placing a tubular metal shaft into the female bladder and allowing the rays of the quartz lamp to be deflected through it. And in spite of this crude method, results obtained by this procedure have been recorded as worthy of future attempts, by excellent men in this field of work. But not until June, 1932, when Caulk and Ewerhardt first demonstrated the feasibility of directly bringing the ultraviolet rays into the bladder by means of the cold quartz generator, could we really give to this organ the true benefits of the rays. Their remarkable results in a case of tuberculous cystitis following the daily use of this agent for a comparatively short time where all other methods had failed, made quite an impression on us. And those of us who see the poor unfortunates

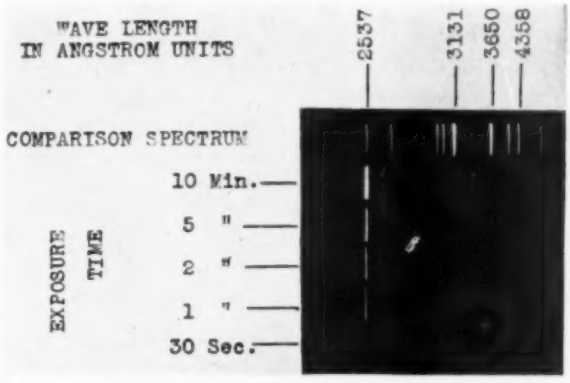

FIG. 2. Spectrum characteristics of intrad ultraviolet light.

* From the Department of Urology, Flower Hospital Medical School.

whose very existence is tortured by the extreme agony that accompanies the urgency, frequency, tenesmus and spasm

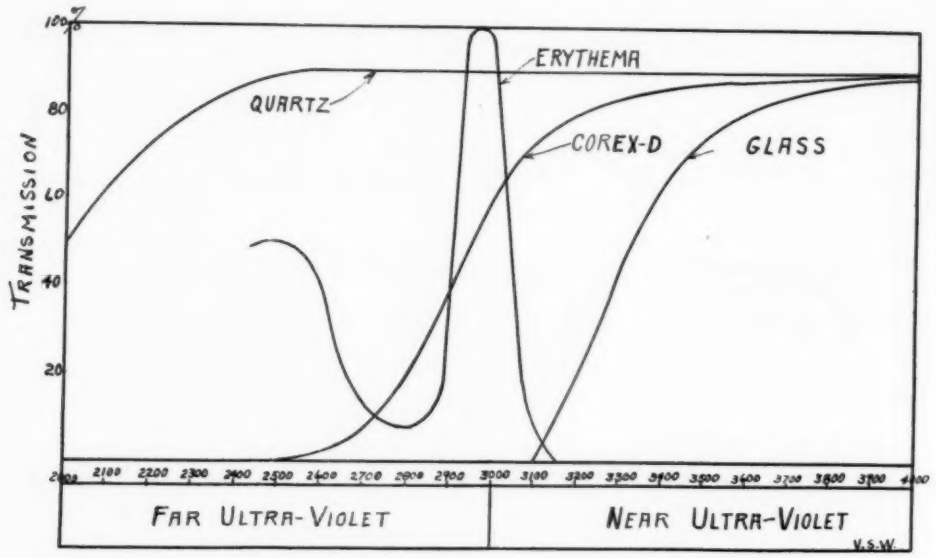

Fig. 3. Graphic comparison of wave lengths.

of a tuberculous cystitis, especially when the original focus (kidney) had been surgically removed, were only too happy to welcome any method that would hold out hope for the alleviation of this malady.

APPARATUS

With this in mind I consulted with Mr. Vincent Wagner, who was able to make a quartz bulb small enough to allow for its passage through the cystoscope and yet large enough to obtain sufficient ultraviolet radiation when completed and attached to a specially devised high frequency apparatus. The completion of this electrode merely consists in attaching a number 9 F. silk woven ureteral catheter, through which is passed a piece of copper wire, which has attached to its proximal end the quartz bulb containing mercury vapor and to its distal end a terminal. The bulb can be made of varying sizes and shapes depending on what its purpose shall be. To this completed arrangement we shall temporarily give the name of Internal Ultraviolet Electrode for want of a better term.

SPECTRAL RAYS

It now seems to be the consensus of opinion after much experimental work, that the germicidal action is produced by ultraviolet radiation throughout the spectral range extending from the very short wave lengths (Schumann rays) to and including 3650 Angström units (Coblentz). For a sense of comparison, figure 1 demonstrates (from above downwards) four spectral ranges, namely, quartz, blue filter (black light), corex D, and glass. It is clearly seen that quartz throws spectral lines ranging from 4358 to 2400 Å.u., blue filter from 3650 to 3131 Å.u., corex D from 4358 to 2800 Å.u., and glass from 4358 to 3130 Å.u. It can then be readily concluded that ordinary glass and blue filter which are opaque to wave lengths shorter than 3000 Å.u. practically have little or no beneficial therapeutic ultraviolet rays. Corex D does show a range that puts it into the beneficial class to a limited degree, whereas quartz practically stands alone it its wider range of so-called therapeutic rays. Of this range 95 per cent of its intensity is centered around the band 2537 Å.u., which is well within the range of the maximal bacterial field (Caulk and Ewerhardt). Figure 2 represents the

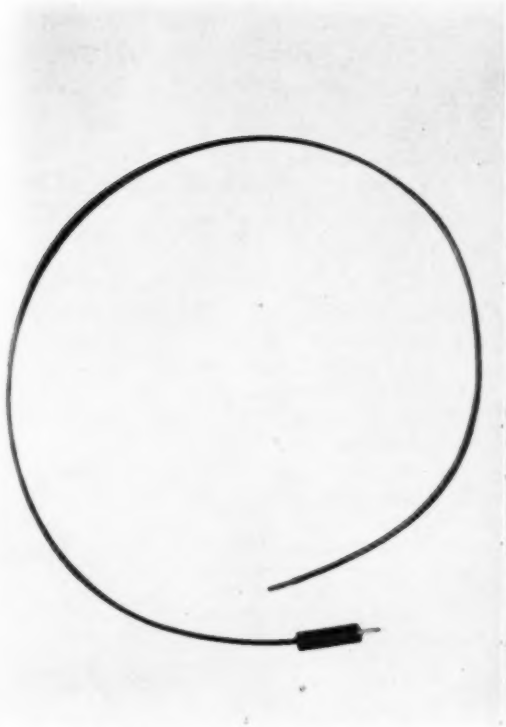

FIG. 4. Internal ultraviolet electrode.

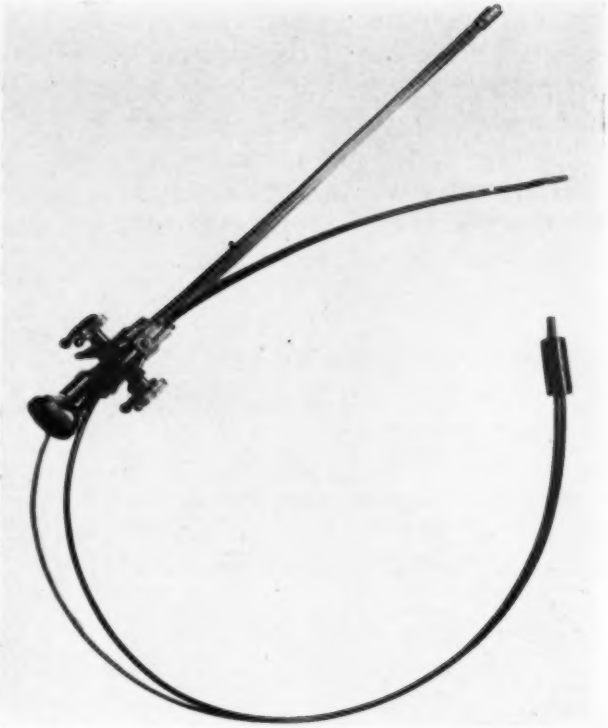

FIG. 5. Ultraviolet electrode and operating cystoscope.

FIG. 6. Ultraviolet application to bladder.

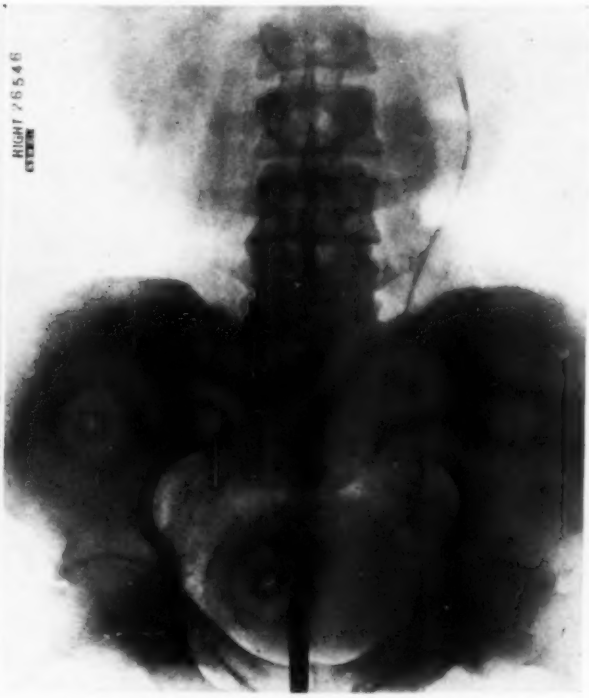

FIG. 7. Ultraviolet application to kidney.

spectral lines obtained as compared to the spectrum by the use of the internal ultraviolet bulb at different time exposures. It shows definitely that we can place the band at 2537 Å.u. From all deductions, we should then be working with as good a band of ray as could be obtained with our present knowledge of their values.

APPLICATIONS

If proved successful its field of usefulness may be wide. Its possibilities in various other systems of the body where application is feasible are numerous. For our purposes for the time being we shall attempt to formulate some conclusions after much work in tuberculosis of the bladder, ureter and kidney, before and after surgical interference, as well as its possibilities in tuberculous sinus tracts. Such reports shall be forthcoming.

I wish to express my gratitude to Dr. Louis Rene Kaufman upon whose service this work is being done at the Flower Hospital.

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The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIAL

EVALUATION OF THE RESULTS OF TREATMENT

PRESENT day literature is replete with new methods and processes for improving or effecting cures. Too frequently, however, the only basis for presenting the new method for publication is an author's results in "100 cases consecutively treated" viewed only from the standpoint of the patient's reported symptomatic improvement. Because these 100 patients showed improvement, by inductive reasoning all others should also. That this sort of contribution is very much to be deplored is almost always made manifest by the contradictory statements of other workers who failed to obtain the improvement or cure in another 100 cases similarly treated. An academic controversy follows, as a result of which medical literature is further cluttered-up with useless material, all because of failure to understand the Scientific Method.

To be of value, it must be possible to check the proposed method by animal experimentation or to demonstrate by definite clinical (serologic, bacteriologic) or histologic tests the presence of a lesion and then have the test become negative by treatment. If, however, the criterion of the value of the method is a symptomatic improvement then the problem falls into the category of biological experiments.

For such experiments 100 cases are a woefully insufficient number from which to draw conclusions. It is often possible

to get what seems to be an almost uniform improvement in 100 cases and then in an appreciable number of subsequent cases to have contradictory findings. For example in a consecutive series of 104 cases of anesthesia induced by subarachnoid block with a No. 22 gauge needle there was no postoperative headache but in each one of the next 17 cases, although there had been no recognizable variation in the technique and the same needle had been used, postoperative headache did develop. A report of the first 100 consecutive cases of spinal anesthesia devoid of postoperative headache as a result of the use of a 22 gauge needle might, in all sincerity, have been published, only to be refuted by the same author subsequently or by some other contributor who would fail to uniformly eliminate such a headache. Similarly another 100 consecutive cases without postoperative headache could be encountered after the use of a No. 18 gauge needle.

The source of error lies not in an inaccuracy of the observer but in his failure to recognize the limitations of the method, namely, the inability to arrive at any valuable conclusions from apparent symptomatic improvement in a small series.

The spinal anesthesia citation is used only as illustrative of the point which is applicable to the problem in any other field of medicine.

A plea is therefore made for the wider recognition of the limitations of this method of observation (reasoning by induction on symptomatic improvement in small series of cases). This of necessity, will diminish the number of prematurely made reports, the number of untried and untrue statements and the number of literary controversies.

H. Koster.

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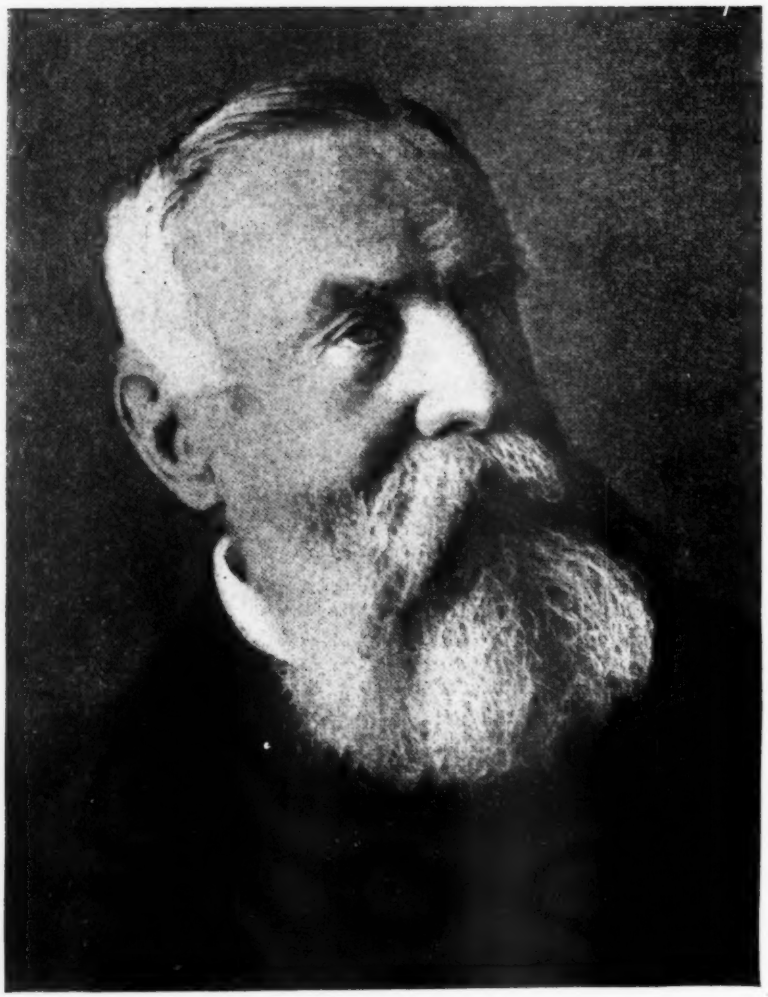

HENRY JACOB BIGELOW

[1818-1890]

AMERICAN PHYSICIANS

HENRY JACOB BIGELOW

HENRY JACOB BIGELOW was born in Boston, March 11, 1818, the son of Jacob Bigelow, first professor of materia medica in Harvard Medical School.

Young Henry graduated from Harvard in 1837 and decided to study medicine. After studying with his father and attending the lectures of Oliver Wendell Holmes at Dartmouth he was appointed house pupil at the Massachusetts General Hospital. Because of lung trouble he migrated to Cuba and, later, to Paris, where he continued his medical studies. He received his M.D. at Harvard, 1841, and finished his training in Paris and London.

He then returned to Boston and within a short time was a conspicuous member of the community. Aided by a fashionable appearance he soon had a large practice and made friends as well as countless enemies by opening a Charitable Surgical Institution.

But Bigelow had marked surgical ability. He bought thousands of surgical instruments abroad and never ceased to add to his collection. He was one of the pioneers in the study of surgical pathology, being one of the earliest microscopists in the country. He published a treatise on orthopedic surgery in 1844 which won for him the Boylston prize for that year.

In 1845 he was appointed instructor in surgery in the Tremont Street Medical School. The next year he was appointed visiting surgeon to the Massachusetts General Hospital. Here he witnessed the first use of ether in surgical anesthesia. He became professor of surgery at Harvard in 1849 and held this position until 1882, when he was made Professor Emeritus. He resigned as visiting surgeon to the Massachusetts General Hospital in 1886.

Bigelow was a brilliant and finished surgeon. In 1852 he excised the hip joint for the first time in America.[1] In 1869 a volume appeared entitled "Mechanism of Dislocations and Fractures of the Hip, with the Reduction of the Dislocation by the Flexion Method." He perfected an instrument that would lessen the danger of the operation of lithotomy and shorten the duration of the treatment and published his results in 1878.[2] In 1878 he wrote an essay entitled "Lithotrity by a Single Operation." He demonstrated the Y-ligament of the hip joint.

Without doubt Bigelow was the leading surgeon in New England during his life.

After Charles W. Eliot became president of Harvard University, 1869, certain changes and improvements were planned for the Harvard Medical School. These Bigelow, who was chairman of the medical faculty, fought bitterly. Time has shown that Bigelow was wrong. To have followed his advice would have been a backward step. We find Bigelow opposed to allowing the visiting staff of his hospital to treat their patients in the hospital and accepting fees. He also was opposed to coeducation in the medical school, and to vivisection.

Bigelow married Susan Sturgis in 1847 and a son, Dr. William Sturgis Bigelow, resulted from this union.

Retired to his country estate, Oak Hill, Newton, he suffered an accident from which he never fully recovered. He died there on October 30, 1890.

T. S. W.

[1] *Am. J. M. Sc.*, 24: 90, 1852.
[2] *Am. J. M. Sc.*, Jan., 1878.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

"LEST WE FORGET"*

LOUIS FRANK, M.D.

LOUISVILLE, KY.

IN THE development of man on his moral or social side Sentiment and Tradition have played almost if not quite the largest part. Their effect upon our civilization has been tremendous and inestimable. Sentiment is an intellectualized emotion, it is thought blended with feeling and is largely the origin of all other emotions and is the basis of all traditions. Traditions are our finest possessions not only as a people but as a profession. Our traditions are subconsciously continually stimulating us to nobler efforts and endeavors. It is with a sense of this in mind that tonight I am making a gift to the Southern Surgical Association which I hope may, in a concrete way, be representative of the great traditions and written history of our specialty in the South and may further be a constant reminder to the coming surgical generations of the courage and lofty purpose which dominated our forebears in medicine.

I

Kentuckians, by birth or adoption, are prone to visualize the work of Ephraim McDowell when thinking of abdominal surgery.

Before I speak of McDowell, however, I wish to pay my respects to a heretofore greatly neglected pioneer surgeon of the Mother State, Virginia, and to call to your attention

* Address upon the presentation to the Southern Surgical Association of two Sand Glasses mounted in wood from the Ephraim McDowell Home with a silver plate made of a spoon which belonged to Dr. Walter Brashear.

the fact that Dr. Jesse Bennett did in 1794 perform a cesarean section and double ovariotomy upon his own wife.

Dr. Bennett antedated McDowell by fifteen, and John Richmond, who, Garrison says, "performed the first Caesarean section in this Country at Newtown, Ohio," by thirty-three years. Yet his operation was not published for the reason, as he says, "No Doctor with any feeling of delicacy would report an operation he had done on his own wife, no strange doctor would believe the operation could be done in the backwoods of Virginia and the mother live, and he'd be damned if he would give them a chance to call him a liar."

May I here quote an abstract from a letter by Dr. F. H. Garrison to Dr. Howard Kelly anent some inquiries concerning Dr. Bennett:

> On January 14, 1794 Jesse Bennett's wife was confined in her first pregnancy. The Bennetts then lived in the frontier settlement in the Shenandoah Valley (Timber Grove). Her labor was a very difficult one due to a contracted pelvis, and Dr. Alexander Humphreys of Staunton was called in consultation. The doctors tried forceps without success. Between the alternatives of craniotomy and Caesarean section the patient chose the latter in spite of the opposition of Dr. Humphreys and his persistent refusal to perform such a dangerous operation. The case was urgent and Jesse Bennett decided to operate himself. The patient, stretched on a crude plank table over two barrels, was put under the influence of a large dose of opium. Assisted only by two negro women, the courageous frontier surgeon by one quick stroke of the knife laid open the abdomen and uterus and quickly delivered child and placenta. At this stage he delayed long enough to remove both ovaries. As one of the witnesses declared "he spayed her, remarking as he did so, this shall be the last one."
>
> The wounds were closed with a stout linen thread and contrary to the expectation of every one present Mrs. Bennett was soon well and active. The child a daughter lived to be seventy-seven years of age.
>
> In appraising this operation of Dr. Bennett's it must be recalled that a successful cesarean section on a living mother was a practically unheard of procedure anywhere in the world at this time. The oophorectomy performed by Dr. Bennett antedated McDowell's famous operation on Mrs. Crawford by more than fifteen years.
>
> Jesse Bennętt, of French descent, was born at Frankfort, Pennsylvania, July 10, 1769. After reading medicine with several Philadelphia physicians he completed his education at the University of Pennsylvania. One who knew him well declared him to be "a thorough anatomist and a most excellent surgeon." In 1792 he settled in the Valley of Virginia, then on the frontier of civilization. The next year he married Elizabeth Hog, daughter of Major Peter Hog, an Edinburgh graduate, a pioneer lawyer and a veteran of the French and Indian Wars. In 1794 Bennett performed the cesarean section upon his wife and thereafter enjoyed an extensive reputation as a surgeon. In the summer of that year, as an army surgeon,

he joined the forces sent to suppress the Whiskey Rebellion. Two years later, the Bennetts moved to a 9000 acre tract on the Ohio River near the mouth of the Great Kanawha. In 1804 Dr. Bennett's land was included in the newly created Mason County, now in West Virginia. He became the first justice of this county, served as major in the county militia and also represented the county in the Virginia Assembly. We next hear of him as a witness in the Aaron Burr trial. Burr had tried to persuade him to join his ill-fated expedition. Bennett served in the War of 1812 as a surgeon in the Second Virginia Regiment, and after that date we have no record of his activities. He lived many years longer, however, his death occurring July 13, 1842 at Riverview, Mason County, Virginia."

II

In the dedicatory address at Danville, Ky., upon the occasion of the unveiling of the McDowell Monument, Dr. Samuel D. Gross, world famous surgeon, said "McDowell is not the only physician Kentucky has reason to be proud of. She furnished the first case of hip-joint amputation on this continent in the hands of Dr. Walter Brashear of Bardstown." Dr. David Yandell said this was the first successful hip-joint amputation ever done.

This was in August, 1806, and was really the first original and successful surgical work of any magnitude done in the Commonwealth of Kentucky. It was necessitated by a compound comminuted and multiple fracture of the femur in the person of a seventeen-year-old mullato slave boy. The procedure was first to amputate at the middle third of the thigh at which time the vessels were all tied, then the bone was exposed to the head by an incision on the outer side of the thigh and the head of the femur disarticulated. And all this without anesthesia or antiseptics. Brashear also never published an account of his operation.

A word or two concerning Dr. Walter Brashear. Of English ancestry, he was born in Maryland in 1775 the family moving to Bardstown, Ky., when he was quite a lad. He took his literary degree in 1796 at Transylvania, the first and most famous institution of learning west of the Alleghanies. Finishing his course at College he studied medicine with Dr. Fred Ridgely of Lexington, Ky., and later went horseback to Philadelphia where a year was spent at the University of Pennsylvania (1799). Here he listened much to Rush, Physick and Barton and came largely under their influence. Finishing his medical studies he shipped for China returning several years later to his home in Kentucky where the afore-mentioned

operation was performed. Later he went to Louisiana, entered politics was elected to and served in the U. S. Senate, dying October 23, 1860 at the age of eighty-four.

Fig. 1.

Fig. 2.

III

The early nineteenth century as its latter part was productive of some great surgeons in the South. The outstanding one, whose work was the most far reaching in its results, whose

name is known in every clime, in every Country the world over, called the Savior of Women, Ephraim McDowell, was born in Rockbridge County, Virginia, in November, 1771, dying in Kentucky in June, 1830. It is needless for me to tell this Society of the work upon which the fame of McDowell rests or to go into details as to his first ovariotomy upon Mrs. Jane T. Crawford, a resident of Green County, Kentucky. Mrs. Crawford lived to be seventy-eight years old and lies buried in Indiana, in Johnson Cemetery near Graysville, Sullivan County.

Was there any connection between Bennett and McDowell? It is quite likely they knew each other and probably quite well as Dr. Bennett lived at Timber Grove, now Timber Ridge, a very short distance from Staunton. McDowell was a student of Dr. Alexander Humphreys, who was Bennett's consultant when he operated upon his wife, and resided with Humphreys two or three years though he was a student in 1794 in Edinburgh at the time of the cesarean operation. Yet the coincidence of the geographic location, of the influence of and the association with Humphreys, of the character of epoch-making surgery and of its daring are certainly quite striking. There was this difference, Bennett's operation was done under impelling circumstances, McDowell's operation was deliberate and definitely planned. One wonders if these pioneer students had ever discussed such procedures with Humphreys.

Of Dr. Alexander Humphreys little is known. Notwithstanding diligent search there is little information to be had concerning him. We know he was one of four physicians residing and practicing in Staunton, Virginia, at the end of the eighteenth century. He was a man of wide reputation, an excellent anatomist and was much sought after in consultation work and in surgery. That he was a man of parts is attested by the character of his students, one of whom was McDowell, possibly Bennett also, another the great Dr. Samuel Brown, one of the Founders of Transylvania University and one of the lecturers in the Medical Department. Brown graduated at Edinburgh, had a very high reputation and an extensive practice. With this knowledge one feels sure that both Bennett and McDowell must have felt the influence of Humphreys.

Like the great Louis and many other of the truly great, McDowell also was modest, and though his first ovariotomy

was done in 1809 it was not until October, 1816 that his cases, three in number, were published in the *Eclectic Repertory and Analytical Review* of Philadelphia, the only medical journal then in existence in the United States.

He performed from December 13, 1809 to October, 1826 eight ovariotomies, four on whites and four on negroes. Two of his operations were incomplete in that the sac was not removed yet but one patient died, with a dermoid cyst of the left ovary, a mortality of 12 per cent. Can you equal it? Consider the character of the cases, the difficulties under which they were performed, no anesthetic, no antiseptics, no trained assistants, no trained nurse to help and no finished operating room and again I ask, can you, do you think, equal it. These were the days of men.

It is the pioneer Anglo-Saxon spirit which has made this great country what it is, has maintained it as our fathers fashioned it and which engenders the courage and fortitude which will see it through the present crisis despite the mismanagement of politicians and the grasping clutches of the great Money Barons.

IV

Picture the home and office still standing in Danville where this epoch-making work was done in a country village with a population less than 500 although it was a center of culture then as now. This historic edifice is now occupied by negroes and some years ago in their ignorance some of the precious wood of this famous domicile was torn out to build a fire. A friend of mine happened by, chastised the negroes and deprived them of the fruits of their vandalism. Some of this wood came to me.

One is always reminded by the "Hour Glass" that his own "sands of time" are running out and as this thought comes home to him he grows possibly a bit sentimental. God pity the man or woman who does not soften with age. Possibly such ideas and the knowledge that you had an historic gavel may have stimulated *me* to have prepared from the McDowell wood and the silver spoon which fed the young Brashear this gift for the Society. Because also I believe in sentiment and upholding of traditions the hope is cherished that these "Sand Glasses" in addition to their practical value in reminding you of the limit of your discussion may be to you and our

future members an emblem not only of the Great Southern Pioneers in surgery but also the honorable traditions of this Association.

And in conclusion may I add the following prayer written by McDowell himself on the fly-leaf of his prayer book:

Almighty God, be with me, I humbly beseech Thee in this attendance in Thy holy house; give me a becoming awe of Thy presence; grant me Thy direction and aid; that in confession I may be humbled, and truly penitent in prayer, grateful and sincere; and in hearing Thy word attentive and willing and desirous to be instructed; give me true faith in the atonement of Thy Son as alone sufficient to procure Thy favour and blessing; that worshipping Thee in spirit and in truth, my service may be accepted, through his all sufficient merits.

Amen.

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BOOK REVIEWS

THE DUODENUM. Its Structure and Function, Its Diseases and Their Medical and Surgical Treatment. By Edward L. Kellogg, M.D., F.A.C.S. With a Foreword by George David Stewart, M.D., F.A.C.S., Chapter on Duodenal Parasites, by Bailey K. Ashford, M.D., SC.D., Section on X-Ray Diagnosis by A. Judson Quimby, M.D. N. Y., Paul B. Hoeber, Inc., 1933.

As Dr. Stewart indicates in his Foreword, this monumental volume does for the duodenum what Dr. Howard Kelly's book did for appendicitis years ago. Here we have finally in one volume all the available data on the diseases of the duodenum and their treatment, both medical and surgical. The author is to be congratulated on his thoroughness and carefulness and for the spirit of conservatism which is reflected on every page. Anyone interested in the affections of the duodenum (and what surgeon is not?) will find this book of incalculable value.

The illustrations, of which there are almost 300, are well selected and well executed. In the table of references (over 100 pages) every worthwhile article on the subject is listed, lending a stamp of authority to the material in the book. The careful index of both personal names and subjects makes for easy reference. The book-making like the text leaves little room for criticism. It is seldom that the reviewer is able to give unstinted praise to a book submitted for review but in this case he feels that this can be done without hesitancy.

DISEASES OF THE HEART. By Sir Thomas Lewis. N. Y., Macmillan Co., 1933.

According to Dr. Lewis' Preface, this book represents "the outline of my clinical teaching on diseases of the heart, as this has developed in my talks to my own hospital students." The book, therefore, presents in permanent form the interesting lectures that Sir Thomas has been giving for the last twenty years.

The best idea of the book can be obtained from a few more quotations from Sir Thomas' Preface. He says, "I determined that the basis of what I taught should be that which I myself had seen and proved to be true"; "It was apparent that little of the graphic work could profitably be taught to men entering practice, whose foremost interest must always be in observations they themselves can make upon their patients."

The book is written strictly along these lines in the direct and terse language with which we have become familiar in Dr. Lewis' writings. In no way replacing a complete textbook on the heart, this work will be valuable supplementary reading for every physician and surgeon.

THE EARLY DIAGNOSIS OF THE ACUTE ABDOMEN. By Zachary Cope, M.D., M.S. Lond., F.R.C.S., Eng. Ed. 6, Oxford Univ. Press, 1932.

The sixth edition of Cope's volume on "The Early Diagnosis of the Acute Abdomen" has been brought quite up-to-date. The fact that there have been nine printings since 1921 would indicate that there is a real demand for this practical volume.

The question of what is the acute abdomen is perhaps best answered by the Table of Contents, the nineteen chapters of which cover the following subjects: The Principles of Diagnosis in Acute Abdominal Disease; Method of Diagnosis: (I) The History; Method of Diagnosis: (II) The Examination of the Patient; Appendicitis; The Differential Diagnosis of Appendicitis; Perforation of a Gastric or Duodenal Ulcer, Acute Pancreatitis; Acute Intestinal Obstruction; Intussusception; Cancer of the Large Bowel—Volvulus; The Early Diagnosis of Strangulated and Obstructed Herniae; Acute Abdominal Symptoms in Pregnancy and the Puerperium; Ectopic Gestation; Cholecystitis and Other Causes of Acute Pain in the Right Upper Quadrant of the Abdomen; The Colics; The Early Diagnosis of Abdominal Injuries; The Acute Abdomen in the Tropics; Acute Abdominal Disease with Genito-Urinary Symptoms; The Diagnosis of Acute Peritonitis; Diseases which May Simulate the Acute Abdomen.

THE MANAGEMENT OF ABDOMINAL OPERATIONS. By R. H. Maingot, F.R.C.S. England. N. Y., William Wood & Co., 1932.

The object of this book, as stated in the first lines of the Preface, is as follows: "The intention of this little manual is to provide a practical scheme of reference for general practitioners, house surgeons, and others who may, at any time, be in charge of a patient awaiting, or having just undergone, a surgical operation."

The purpose here expressed is well carried out though it is felt that the material will be available elsewhere to most American surgeons.

GYNÄKOLOGISCHE OPERATIONSLEHRE. By Prof. Dr. Josef Halban. Berl., Urban & Schwarzenberg, 1932.

This is a short practical treatise on modern operations in gynecology. Illustrated in sumptuous fashion with over 398 halftones, some of which are colored, the modern German technique is well presented in this volume, which will be found of great value to the gynecologist.

DIE CHIRURGIE DER WIRBELSÄULE. By Ernst Gold. Stuttgart, Ferdinand Enke, 1933.

This is a concise monograph on surgery of the spinal column and represents the 54th volume of the Neue Deutsche Chirurgie published by H. Küttner.

The book is rich in excellent reproductions of *x*-ray films which clearly illustrate the subject matter. The material is divided into eight chapters which deal with injuries of the spinal column, inflammatory processes, tumors, osteopathies, congenital anomalies of the spinal column and diseases of the lumbosacral region, spina bifida injuries, and diseases of the sacrococcygeal region, and the surgical treatment of scoliosis.

The author's obvious large amount of material has made it possible for him to present an excellent and concise review of our present knowledge on the clinical symptoms, pathology, radiology, and surgical treatment of the surgical lesions of the spinal column.

SECTION ON ANAESTHETICS, PROCEEDINGS OF THE ROYAL SOCIETY OF MEDICINE, Vol. XXV. Edited by Hugh Thursfield, M.D., and J. Swift Joly, F.R.C.S., Under the direction of the Royal Society of Medicine, Lond., Longmans, Green & Co., Ltd., 1932.

This volume, giving the Proceedings of the Section of Anaesthetics of the Royal Society of Medicine, presents in a few pages, papers by the leading men of England. The Discussion on Anaesthetics for Diathermy and Endoscopy is very satisfactory. This is a subject that has been more or less neglected in the literature.

A TEXTBOOK OF SURGERY. By John Homans, M.D. Ed. 2, Springfield, Ill., Charles C. Thomas, 1932.

The first edition of this book, published in 1931, evidently met with a great deal of success for the work is already republished in a second edition which has given the author an opportunity to delete, as he puts it, "many redundant, obscure or incorrect passages" and to add such new material as has developed in the short interim.

The opportunity has also been afforded for the addition of a very desirable and well-written chapter on Modern Methods of Anesthesia. Now, thoroughly up-to-date, this book is sure to retain the popularity already so firmly established.

ACUTE INTESTINAL OBSTRUCTION

MONROE A. McIVER, M.D., F.A.C.S.

FOURTH INSTALLMENT

PART I: THE DISEASE

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Chapter VIII

VARIETIES OF OBSTRUCTION (Continued)

Obstruction by Neoplasms

Obstructions from neoplasms form an important group, constituting about 17 per cent of all cases of obstruction, exclusive of those caused by external strangulated hernias (Fig. 2*). The group assumes even more importance if the age incidence is considered, for it is the most common cause of obstruction (again exclusive of hernias) in patients past middle life. (Fig. 3.†)

Tumors causing obstruction may be divided into two main groups: the first and much the more important comprises the primary tumors originating in the bowel; the second, the metastatic implantations.

Of the 32 cases of neoplasm reported in the 1918–1927 Massachusetts General Hospital series, 19 were due to primary carcinoma of the bowel, and 6 to metastatic carcinoma. There was one case of primary tumor of the mesentery, the exact type of which was not determined. As would be expected, in so small a series there were very few carcinomas of the small intestine: only 2 were of this type.

Primary Neoplasms. Primary carcinoma arising from the large intestine is the most frequent type of primary neoplasm responsible for acute obstruction. Sarcomas[1] and carcinomas [2–4] arising from the small intestine are rare tumors; they do not often produce complete obstruction.

While a growth situated anywhere from the cecum to the sigmoid may produce an acute obstruction, those arising from the sigmoid account for about half of these obstructions of the large intestine. In Table vii is shown Miller's[5] analysis of 129 cases of carcinoma of the colon admitted to the Johns

* Figure 2 appeared in the January issue of the Journal, p, 177.

† Figure 3 appeared in the January issue of the Journal, p. 180.

Hopkins Hospital from 1889 to 1919, showing their location and the presence or absence of obstructive symptoms. In this series a carcinoma of the sigmoid was accountable for an acute obstruction in 12 instances, the remaining 13 acute obstructions being about equally distributed among the other anatomical divisions of the large intestine. It will be noted that carcinoma of the cecum is a relatively common tumor (see also Erdmann and Clark[6] and Rankin and Scholl[7]) but complete obstruction is rare. Miller's figures (Table VII) do not include carcinoma of the rectum. Carcinomas of the rectum occur about as frequently as carcinomas of all the rest of the large intestine taken together; but only rarely do they produce complete obstructions.

Etiology and Mechanism. Three important types of carcinoma arising in the large intestine may be distinguished.

The first type is adenoma destruens, a typical malignant tumor having a tendency to ulcerate early and extend relatively rapidly. It may, according to Ewing,[8] be a bulky tumor in the cecum and is prone to produce wide superficial extensions in the bowel wall. It is often found in the sigmoid, and may produce acute obstruction relatively early.

The second type is the stenosing fibrocarcinoma. Here the lesion may be sharply circumscribed, and has a tendency to encircle the lumen, producing a tight, annular stricture due to the cicatricial contraction. These annular neoplasms may be present in any portion of the colon; and they may at times be multiple. Ewing suggests that this type often starts as an adenoma destruens and that relatively resistant tissue leads to early fibrosis and cicatrization. As would be expected from the stenosing tendency of this type, acute obstructions frequently result.

The third type of carcinoma in the large intestine is the gelatinous adenocarcinoma, which has a tendency to ulcerate extensively; degeneration and sloughing of the tumor in the lumen of the bowel keeps pace with the external growth of the neoplasm, so that, although a large bulky tumor may be

present, complete obstruction does not usually follow. Codman[9] points out that intestinal tumors of large size, usually sarcomas, rarely cause complete obstructions, for they are likely to slough out centrally as they grow peripherally.

An acute obstruction from neoplasm is usually produced, therefore, either by an adenoma destruens, or, more commonly, by a stenosing fibrocarcinoma. Blockage of the lumen generally comes about by a combination of the growth of the tumor mass and the process of cicatrization. Inflammatory swelling and edema usually play an important rôle, as is shown by the fact that if an obstruction is relieved by drainage of the bowel above, and the inflammatory process is allowed to quiet down, there will frequently be a resumption of the passage of fecal matter by rectum. Occasionally a mass of undigested food may, by becoming impacted in the stenosed lumen, convert a partial obstruction into a complete one. Not infrequently a carcinoma of the colon will lead to a chronic intussusception, the tumor mass in the lumen acting as a foreign body; the intussusception usually involves a rather small section of the bowel.

Metastatic Tumors. Neoplasms that are not primary in the bowel wall may produce acute intestinal obstruction. These tumors are for the most part carcinomas. They frequently arise from the pelvic organs in the female: the uterus and adnexa. Occasionally the primary growth may be situated in the other abdominal structures, such as the stomach, gall bladder, etc. Rarely, a sarcoma or other type of metastasizing neoplasm may be responsible for an obstruction.

Metastatic neoplasms may produce obstruction by involving the bowel in local extensions of the growth. It is fairly common to have the sigmoid involved in such a manner; thus, for example, a carcinoma arising from the ovary may extend around the lower portion of the sigmoid and completely occlude the lumen. On the other hand, a metastasis may occur anywhere in the peritoneal cavity, and by involvement of some neighboring loop of bowel produce obstruction; and at

times a carcinoma that has become implanted in a mesenteric lymph node may spread upwards in the lymphatics of the mesentery and encircle the bowel. Occasionally a lymphoblastoma involving the mesenteric lymph glands may, likewise, produce an acute obstruction. Among these rarer types of tumors must be mentioned endometrial implants,[10, 11] which may infiltrate the intestinal wall and encroach upon the lumen.

Pathology of the Bowel above the Obstruction. The bowel above the neoplasm is dilated. If a chronic obstruction has existed for some time before the acute attack, the bowel wall may be thickened, hypertrophied and edematous. Some of the greatest degrees of abdominal distention seen in cases of acute obstruction are encountered in obstructions of the left side of the colon; and distention is apt to be a particularly striking feature in cases where an acute obstruction supervenes on a partial obstruction which has been present for some time.

Interference with the Circulation. The point has been made a number of times that interference with the circulation of the bowel is of two types: one in which the mesenteric vessels are occluded; and another in which the blood supply of the smaller arterials, venials and capillaries of the wall itself is impaired.

Capillary Interference. Interference with the capillary circulation comes about as a result of distention of the bowel wall and is frequently encountered in obstructions of the large intestine by neoplasm. Gaseous fermentation is more active in the colon than in the small intestine, and interference with the circulation of the bowel from the resulting distention is of relatively frequent occurrence. Since the cecum is the most distensible portion of the large intestine, damage to the capillary circulation is most frequently found in this portion of the canal. As would be expected, it is the anterior surface of the cecum (that is, the part farthest away from the entrance of the blood supply) that suffers first. The changes may vary from dusky cyanosis to actual necrosis and gangrene,

perforation of the cecum and general peritonitis being the not infrequent termination of an unrelieved obstruction of the colon.

Perforation of the bowel with general peritonitis is sometimes the result not of the effects of distention but of an ulcerative, gangrenous process in the obstructing neoplasm itself; this, however, is not of very frequent occurrence.

Mesenteric Interference. Although the large intestine is particularly likely to suffer from distention, which causes interference with the circulation in its wall, it is relatively immune to interference with its mesenteric blood supply. In the first place, most of the obstructions by neoplasms of the large intestine are the result of a stenosing process or of occlusion of the lumen; so that the mesentery would naturally not be involved in the process. In the second place, the only portion of the colon that ordinarily has a definite mobile mesentery is the sigmoid; the vessels to the remainder of the large intestine are better protected than are the vessels in the mobile mesentery of the small intestine. For these two reasons, obstructions of the large intestine, in general, even those caused by bands and adhesions, rarely interfere with the mesenteric blood supply. Almost the only exceptions to this are in the case of volvulus of the sigmoid or cecum, and those in which a portion of the large intestine is strangulated in a hernial sac.

Rarely neoplasms arising in the mesentery, usually lymphosarcomas, may involve the blood vessels of that structure and produce infarction of the adjacent segment of bowel; there was one example of this condition among the tumors in the Massachusetts General Hospital series.

Occasionally, also, a carcinoma spreading along the mesenteric lymphatics may surround and occlude a large vessel and thus likewise produce an infarction of a segment of large intestine. Case XVII illustrates this condition:

CASE XVII. *Obstruction from carcinoma of the sigmoid complicated by metastatic occlusion of the inferior mesenteric artery.*

No. 251,331, M. G. H. Female, aged fifty-five. The patient had been losing strength and weight for several months and had had mild intestinal disturbances and increasing constipation for six months. For four days before admission there had been no bowel movements, and the patient had been vomiting; there had also been increasing abdominal distention. It was said that one week before the attack she had passed a tarry stool.

The patient was operated on under local anesthesia. The colon was found greatly distended, and a colostomy was performed. The patient died eighteen hours after operation.

Autopsy showed a carcinoma of the sigmoid, producing obstruction at that point. There was also an extension of the neoplasm around the inferior mesenteric artery, completely occluding it. This had resulted in hemorrhagic infarction of the left side of the colon, with necrosis and perforation.

Clinical Course of the Disease. *Subacute Stage.* Since obstruction from neoplasm depends upon the growth of a tumor and the gradual stenosis of the lumen of the bowel, the process is ordinarily slow and progressive, and there is usually a partial or chronic obstruction for some time before the occlusion of the lumen becomes complete. The symptoms shown during this stage of the disease depend in large part upon the completeness of the obstruction: they may vary from the mildest symptoms, only to be elicited by the most careful questioning, to symptoms that obviously suggest obstruction.

The symptoms of chronic obstruction are usually those of an obstinate and often progressive constipation; but on the other hand the presenting feature may be an obstinate diarrhea. The condition described by the patient as "diarrhea" often consists of the frequent passing of a small amount of thin watery movement, not seldom mixed with mucus or blood; there may be tenesmus.[12,13] Not infrequently the patient is conscious of increased peristaltic activity, with borborygmus; if the obstruction is located in the colon this is usually associated with pain across the lower abdomen. There may be attacks which the patient describes as "indigestion" or "bilious attacks," consisting of a sense of heaviness in the abdomen, often in the epigastrium, with an aversion to food

and occasional attacks of nausea and vomiting. Not infrequently the patient complains of a fullness of the abdomen, often described as "bloating."

The symptoms of chronic obstruction may at any time be converted into those of acute obstruction. One may be able to recognize a definite time at which there was a marked exacerbation of the symptoms; or the condition may pass into that of an acute obstruction in a very insidious manner. About two-thirds of the acute obstructions from neoplasms, whether from a primary or a metastatic tumor, have a history of definite symptoms of subacute or incomplete obstruction antedating the complete obstruction by days or weeks or in some cases by several months. In the recent Massachusetts General Hospital series the period of incomplete obstruction was from ten days to several months, the average duration being just short of nine weeks.

Acute Stage. At the time of the patient's entrance to the hospital the obstruction may be complete and acute; but in the greater number of cases it is not, and it is often difficult to say whether the case should be classified as complete or incomplete obstruction. In the foregoing series only those cases were called "complete" in which the symptoms and physical signs were so marked that immediate surgical intervention was indicated. In Miller's review[5] (Table VII) he divides the patients with carcinoma of the large intestine into three groups with reference to obstruction: those showing acute obstruction, those with chronic obstruction, and those with non-obstructive lesions; and states that in every 10 patients with carcinoma of the large bowel presenting themselves for treatment, 4 will show no features of obstruction, 4 will give a definite history of chronic obstruction, and 2 will either be actually obstructed or will give a history of an acute attack from which they have recovered.

Signs and Symptoms. The symptoms of acute obstruction from neoplasm are in general those of acute obstruction from any cause where strangulation is not present: constipation,

pain, distention and vomiting. Since most of these obstructions are located in the large intestine the symptoms have a tendency to be less fulminating than in types of obstruction where the small intestine is involved,[14] and considerable time is likely to elapse between their onset and the time of operation. In the recent Massachusetts General Hospital series the average time between the onset of acute symptoms and the operation was five days. In some cases the obstructive symptoms were very severe over a period of ten days to two weeks; the obstruction was probably not complete over that period, but it was impossible to say at what time the blockage became absolute.

Since strangulation is rarely present in obstructions from neoplasm, the pain may not be particularly severe; it is, however, almost constantly present to some degree. In the early stages the pain is likely to be described as cramp-like or colicky; in the later stages it may lose this characteristic and become constant, although it remains colicky longer in obstructions of the large intestine than it does in obstructions of the small intestine. It is usually localized across the lower abdomen, although occasionally at the onset it is referred to the region of the epigastrium. In some instances acute discomfort from distention is the most outstanding complaint.

Vomiting comes on early with the onset of the acute obstruction, but is not likely, at least in the early stages, to be so profuse or frequent as in obstructions of the small intestine; in the later stages, after the obstruction is well established, and as the small intestine becomes more and more involved in the obstructive process, the vomiting may be profuse and of the typical "fecal" character.

Distention is likely to be a very marked feature in obstructions of the large intestine. In the early stages, visible peristalsis of the large intestine above the point of obstruction is not frequently seen. In attempting to say whether an obstruction is complete or not, the question of whether there is any passage of flatus either voluntarily or on the administration of an enema is an important criterion. There is usually little or no

systemic reaction, the temperature and white blood cell count being generally normal.

Age and Sex. Since carcinoma of the colon occurs almost twice as often in the male as in the female, we naturally find a similar ratio in intestinal obstruction by carcinoma.

The ages of the patients in a recent series are shown in diagrammatic form in Figure 3.* Following the incidence of carcinoma in general, it will be seen that obstruction from neoplasm is a disease of late middle life.

Two typical histories follow:

CASE XVIII. *Obstruction by carcinoma of the sigmoid.*

No. 228,768, M. G. H. Male, aged fifty-seven. Patient had two weeks of gradually increasing constipation, requiring large doses of cathartic to obtain a movement. For the past seven days there have been no bowel movements. During this time the patient has vomited practically everything taken by mouth and enemas have produced no results, either feces or gas. During this time there has been indefinite, generalized abdominal pain, cramp-like in character.

On physical examination, the temperature was normal and the white count 8000. The examination was essentially negative except for the abdomen, which was distended, with visible peristalsis seen to the right of the umbilicus. The left upper quadrant appeared more distended than the remainder of the abdomen. There was a question of an indefinite mass in the left lower quadrant.

The patient was operated upon soon after admission and a carcinoma of the sigmoid was located. A colostomy was done above the growth. The patient recovered uneventfully from this operation. Two weeks later the tumor was resected. The patient was discharged relieved.

Comment: The patient's age, together with the rather mild course of the disease, would suggest the diagnosis of obstruction by carcinoma of the large intestine.

CASE XIX. *Obstruction by carcinoma of the sigmoid.*

No. 248,046, M. G. H. Male, aged sixty. For the past few months the patient has had obstinate constipation relieved by cathartics. He has suffered from general malaise, loss of appetite, weakness and gradual loss of weight. Eleven days before admission the abdominal discomfort and distention increased. Enemas gave unsatisfactory results. Four days before

* Figure 3 appeared in the January issue of the Journal, p. 180.

admission he began to vomit foul-smelling material at frequent intervals. The distention and abdominal discomfort were extreme.

Physical examination showed an emaciated man with evidence of considerable dehydration. The abdomen was distended, tense and tympanitic. No mass was felt; there was no visible peristalsis. Temperature and white blood count were normal.

The abdomen was explored at once, under novocaine and ether anesthesia. The whole colon was greatly distended. A mass could be felt in the region of the sigmoid. A section of the sigmoid above the growth was brought out as a colostomy. The patient did not rally from the operation and died the next day. Autopsy showed general peritonitis and hemorrhagic edema of the lungs, in addition to the carcinoma of the sigmoid.

Comment: This case represents an end stage of obstruction by carcinoma of the sigmoid. The patient had had complete obstruction for several days before operation.

The operation of choice for obstructions of the left side of the colon by neoplasm is a cecostomy.

Partial or Subacute Obstructions. During the years from 1918 to 1927 inclusive, there were at the Massachusetts General Hospital 24 cases in which the patients were operated upon for subacute obstructions due to tumor. There were 12 other patients in whom the obstructive symptoms were a rather marked feature of the disease but not severe enough to warrant their consideration even in the group of subacute obstructions. Of the 24 cases with subacute obstruction, the blockage in 19 instances was due to a primary carcinoma of the large intestine; in 5 instances to metastatic involvement of the small intestine. The average duration of symptoms in these patients before their entrance to the hospital was six weeks.

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Table VII

SITE OF GROWTH IN THE THREE CLINICAL GROUPS

Site of Growth	*Number of Cases*	*Acute Obstruction*	*Chronic Obstruction*	*Non-obstructive*
Cecum	50 (38%)	2	24	24
Ascending Colon	5 (4%)	1	1	3
Hepatic Flexure	12 (9%)	2	6	4
Transverse Colon	7 (5%)	4	2	1
Splenic Flexure	8 (6%)	2	3	3
Descending Colon	6 (5%)	2	1	3
Sigmoid	40 (31%)	12	16	12
Hepatic Flexure combined with 2nd Growth in Ascending Colon	1 (0.7%)			
Total	129	25	53	50

Miller divides his cases of neoplasm of the large intestine into those showing acute obstruction, those showing chronic obstruction and those with no symptoms of obstruction. It will be noted that by far the largest number of obstructions occur in the sigmoid. Neoplasms involving the cecum, while often causing symptoms of chronic obstruction, rather rarely cause acute obstruction. (Miller[5])

Chapter IX

VARIETIES OF OBSTRUCTION (Continued)

Obstruction by Strangulated External Hernia

Strangulation of a loop of bowel in an external hernia is the most frequent single cause of acute intestinal obstruction, accounting as it does for almost half the total number of cases.

Definition. Strangulated hernias must not be confused with incarcerated hernias. The latter term describes the condition existing where a loop of bowel has found its way into a hernial sac, and, due to adhesions or other cause, cannot be returned to the abdominal cavity; such a condition may be tolerated for years without any serious symptoms. The essential feature of the condition known as "strangulated hernia" is interference with the circulation to a loop of bowel contained in a hernial sac; in the great majority of cases there is complete obstruction of the lumen of the bowel at the points where the ends enter and leave the sac. When a strangulation comes about, acute symptoms appear at once and are usually progressive in character. In going over any large series of so-called strangulated hernias, there are certain borderline cases in which it is difficult to decide whether the case should be classified as a strangulation or as an incarceration; the patients not infrequently have presented themselves following the onset of the incarceration of a loop in a hernial sac, and it is hard to say whether or not the element of strangulation is present. Clinically, the criterion for differentiation is the severity of the symptoms (pain, tenderness over the sac, vomiting, etc). At operation the major point for differentiation would be the presence or absence of changes indicating interference with the circulation to the involved loop.

Mechanism of Strangulation in External Hernias. In an external hernia the point of constriction is usually at the hernial ring, although occasionally it may be at the tight neck of the sac. This is important; for occasionally the

hernial sac with its contents may be returned to the abdominal cavity by taxis (without operation), the so-called "reduction en bloc," without recognition of the fact that there is bowel strangulated within the sac. A loop may occasionally be strangulated by bands and adhesions within a hernial sac; or there may be rotation of the coil within the sac. A hernia of considerable size may exist for a number of years with no symptoms of incarceration or strangulation. This depends in large part upon the size of the hernial ring; the smaller rings, as is well known, having a greater tendency to produce strangulation than the hernias with large openings. A loop of bowel may be forced through a tight ring and immediately become strangulated; or after having been incarcerated in a hernial sac for a number of years may suddenly, without apparent cause, become strangulated. Strangulation may follow immediately upon some action that increases intra-abdominal pressure, such as straining, lifting weights, coughing, etc.

Warren and Gould[1] summarize the various older theories of the mechanism of strangulation in hernias as follows: the strangulation occurs because of the elastic compression of the ring; compression of the lower end of the strangulated loop by the distended upper portion; angulation of the distal end of the loop; valvular folding of the mucous membranes; torsion of the loop; interposition of the mesentery; or fecal impaction. None of these alone appears to accord a satisfactory explanation of the strangulation in all cases: an adequate theory must explain both the obstruction of the bowel and the interference with the circulation.

Warren and Gould[1] consider that the inflammation of an incarcerated loop is a fundamental factor and that venous congestion is the first step in the inflammatory process. This is doubtless true; but the fundamental causes responsible for the onset of the inflammation are not always clear. It appears likely (see Mechanism of Strangulation*) that distention of

*January installment, p. 195.

the incarcerated loop may be an important factor in bringing about the strangulation.

Retrograde Strangulation. Rost[2] mentions a rare form, the so-called "retrograde" strangulation, in which two loops of bowel enter the hernial sac, while a third loop, which connects the two incarcerated loops but has not itself entered the hernial sac, becomes gangrenous. This is attributed to kinking of the mesentery of the third loop.

Closely allied to retrograde strangulations are those cases in which a volvulus complicates the hernia. Miller[3] divides these cases into six groups: (1) volvulus of a portion or all of the herniated bowel; (2) volvulus of the small bowel, one loop of which becomes herniated; (3) volvulus of a distal oral loop above an actual strangulated hernia; (4) volvulus, generally of the large bowel, distal to a simulated strangulated hernia; (5) volvulus of the herniated bowel immediately after its reduction; and (6) volvulus of the herniated bowel long after its reduction. The diagnosis of this complication before operation is difficult; occasionally an abdominal mass may be palpated.

Richter's Hernia. There is an interesting type of hernia known as Richter's hernia (Fig. 36), in which a portion of the bowel wall only is constricted in the hernial opening without obstruction of the lumen. This portion may actually become gangrenous. Richter's hernia occurred in 2.2 per cent of the 1487 cases of strangulated hernia reported by Frankau.[5]

Littré's Hernia. In this rare type of hernia a Meckel's diverticulum is present in the sac. Sweet[6] has recently collected all the cases reported in the literature in which the diverticulum was incarcerated or strangulated in the hernial sac.

An acute intussusception has also been reported[7] as forming part of the contents of a hernial sac.

Incidence of Strangulation among Different Types of Hernia. The incidence of the different types of hernia and the relative frequency of strangulation in these types are shown in Table viii. It will be noted that inguinal hernia is by far the

most common form; strangulation, however, is relatively more frequent in the small groups of femoral and umbilical hernias. The distribution of 147 cases of strangulated hernias (Massachusetts General Hospital 1918–1927 series) among the different types is shown in Table IX. The large proportion of strangulated inguinal hernias is due to the fact that this type of hernia is so common.

There is one rare and usually fatal form of hernia not represented in Table IX, namely, the obdurator hernia. Gibson[11] reported 7 cases (collected from the literature) of strangulated hernias of this type, among which there were 6 deaths.

TABLE VIII

INCIDENCE OF DIFFERENT TYPES OF HERNIA AND RELATIVE FREQUENCY OF STRANGULATION IN THESE TYPES*

	Total Cases	*Inguinal*		*Femoral*		*Umbilical*		*Incisional Postoperative Ventral*	
		Number of Cases	*Strangulated*	*Number of Cases*	*Strangulated*	*Number of Cases*	*Strangulated*	*Number of Cases*	*Strangulated*
Mt. Sinai Hosp. New York. Beller & Colp[8] 1925.....	4,139	3,208 (77%)	4%	294 (7%)	32%	167 (4%)	15%	377 (9%)	3%
N. Y. Hospital..... Erdman[9] 1926.....	2,587	2,300 (89%)	1.8%	97 (3.7%)	25.7%	29 (1.1%)	17.2%	145 (5.6%)	5.5%

* It will be noted that inguinal hernia is by far the most common form; strangulation, however, is relatively more frequent in the small groups of femoral and umbilical hernias. Beller and Colp[8] and Erdman.[9]

The portion of bowel strangulated is illustrated by Table X. It will be noted that the small intestine, most frequently the lower ileum, is the part involved in the great majority of cases.

PATHOLOGY. The changes taking place in the bowel wall following strangulation have already been described. They may vary from simple congestion to complete infarction and gangrene; thrombosis of the veins to the involved segment

may occur. The greatest pressure comes at the opening of the hernial sac, and the bowel may show evidences of gangrene at this part while the remainder of the loop in the sac shows only slight changes. Beller and Colp[8] divided the pathological process into the stages of congestion, inflammation and gangrene.

TABLE IX
STRANGULATED EXTERNAL HERNIAS*

Type of Hernia	*Number of Cases*
Inguinal	84 (56%)
Femoral	34 (21%)
Umbilical	18 (18%)
Ventral	9 (6%)
Epigastric	2 (2%)
Total	147

* It will be noted that about half the total number of strangulations occurred in inguinal hernias. While, as shown in Table VIII, strangulation is a relatively infrequent complication among these hernias as compared with the femoral and umbilical hernias, the total number of inguinal hernias is so large that the actual number of strangulations is greater in this group.

TABLE X
PORTION OF BOWEL OBSTRUCTED*

Portion of Bowel Strangulated	*Number of Cases*
Small intestine	127 (86%)
Small and large intestine	13 (9%)
Large intestine	7 (5%)
Total	147

* It will be noted that the small intestine, most frequently the lower ileum, is the part involved in the great majority of cases.

The fluid present in the hernial sac will, of course, vary according to the condition of the bowel: in the early stages of congestion it may be a clear, yellow fluid; where the bowel shows more serious involvement, it may be blood-stained; and if the bowel has already become permeable to organisms, it may be foul-smelling and show flakes of fibrin.

The frequency with which the bowel changes have gone on to actual necrosis in the different types of hernias is illustrated by Table XI. It will be noted that out of the 147 hernias,

necrosis is recorded in 19 instances, or about 13 per cent. This is an end stage of the process of strangulation and, of course, represents delay in bringing the patients to operation.

TABLE X

CASES OF EXTERNAL STRANGULATED HERNIA SHOWING NECROSIS OF BOWEL

Type of Hernia	*Portion of Bowel Obstructed*	*Duration of Symptoms*	*Type of Operation*	*Anesthetic*	*Result*
		5 days	Resection; ends brought out	Spinal procaine	R*
		7 days	Resection; ends brought out	Ether	R
		3–4 days	Resection; ends brought out	Novocaine	D*
Femoral 8	Small intestine	30 hours	Resection; end to end anastomosis	Ether	D
		7 days	End-to-end anastomosis	Ether	D
		2 days	End-to-end anastomosis	Apothesine spinal	R
		4 days	Inversion of necrotic area and enterostomy 8 inches above repair	Novocaine	D
		8 days	Small necrotic area perforated; catheter placed in opening	Novocaine	R
	Small int.	16 hours	End-to-end anastomosis	Spinal novol	R
		? ?	Resection; lateral anastomosis	Spinal by apothesine, sup. by ether	D
Inguinal 5	Small int.	3 days	Inversion	Novocaine	R
		1 day	Gangrenous loop brought outside of peritoneum but not outside of muscle	Novocaine	R
	Trans. colon or sigmoid	4 days	Loop brought out; Mixter tube	Novocaine	D
	Small int.	4 hours	Resection; ends brought out	Ether	D
		24 hours	Resection; lateral anastomosis	Sp. novocaine	D
		5 days	Loop of bowel brought out; Mixter tube	Ethylene	D
Umbilical 5	Small int. and trans. colon	4 days	Resection of small intestine; anastomosis	Ether	D
	Trans. colon	15 hours	Ends brought out	Ether	D
Epigastric 1	Small int.	2 days	Resection; lateral anastomosis	Novocaine	R

* R: recovered. D: died.

Table XI gives certain data in relation to cases of external strangulated hernia with necrosis of the bowel; duration of symptoms, type of operation performed, result, etc. (McIver[10])

The strangulated loop, if not relieved, may perforate and set up an abscess cavity; or it may go on to complete gangrene, with separation of the slough at the neck of the sac. The whole hernial mass may then rupture externally and a spontaneous cure result, with the formation of a fecal fistula; the older

textbooks of surgery record many examples of this end process; but usually before this occurs the patient dies from a peritonitis or from the obstruction of the lumen of the bowel. (See also, Travers.[12])

Toxemia in Strangulated Hernia. There are really two elements responsible for the toxemia in strangulated external hernia. The first is the toxic absorption which takes place from the strangulated loop. At times, due to the constriction at the hernial opening or at the neck of the sac, the strangulated loop is completely isolated from the general cavity, with the result that absorption of toxic products from the gangrenous loop is minimized; occasionally a spontaneous cure is effected, as just mentioned.

The second element is the simple obstruction of the portion of bowel proximal (oral) to the strangulated loop, a factor of considerable importance in the pathological and clinical picture.

The fact that strangulated external hernia presents two distinct elements was essentially recognized as far back as 1912; and Travers'*[12] interesting experiments and monograph on the cause of death in strangulated hernia is a valuable contribution. Briefly, he contended that the cause of death was not the strangulation of the bowel, because the bowel was outside the peritoneal cavity; but that death was due to the obstruction of the intestine above the strangulation.

Clinical Picture and Course of the Disease. *Sex.* The male is subject to strangulated hernia about twice as frequently as the female. In the umbilical and femoral types of

* Travers writes: "I have repeatedly formed herniae in animals, imitating the secondary species of strangulation by drawing a loop of intestine through a small muscular orifice, and the primary by making a tight ligature upon the protruded gut. The former produces inflammation of the strictured bowel, and if the obstruction is complete, the animal dies of general peritoneal inflammation. The latter rapidly induces sphacelus (gangrene), in which state the gut bursts, and speedily gives issue to the contents of the upper bowels. The animal is immediately relieved by the discharge; an artificial anus is formed; and though the experiment is ultimately fatal, the peritoneal surface invariably remains healthy." And again: "The local injury would scarcely affect the system if it were not for the derangement of the intestinal function. It will be found that the symptoms are in all cases proportioned in severity to the degree of obstruction." (Travers, 1812.)

hernia, however, females become strangulated about three times as often as males.

Age. Figure 3* illustrates the ages at which strangulated external hernias occur. It will be noted that while all ages are represented, the period from forty to sixty years is particularly prone to this disease.

Signs and Symptoms. The clinical picture presented by a strangulated hernia is for the most part very characteristic and uniform. The severity of the symptoms usually depends upon the completeness of the strangulation. Pain is practically always present and is likely to come on suddenly with the onset of the strangulation; it is usually severe and at times agonizing. At the onset the pain may be localized in the epigastrium or across the lower abdomen, and is usually described as cramp-like in character. As the obstruction continues, the pain and tenderness, due to increasing inflammation and infection, are more completely localized over the hernial sac.

Vomiting may begin with the onset of the pain and continue with increasing frequency throughout the course of the disease. Just as in other types of obstruction, the vomitus is at first merely the contents of the stomach or upper small intestine, and as the disease continues may become "fecal," consisting of the foul fluid that collects above the point of obstruction.

There may be complete cessation of bowel movements from the time of strangulation, or the lower segment of bowel below the strangulation may be emptied. In types of hernia where a section of the wall of the bowel only is strangulated, without obstruction of the lumen, bowel movements may continue throughout the course of the disease; under these conditions diarrhea is not infrequent.

On physical examination there is usually an obvious hernial sac which is tender and irreducible. If the hernia has persisted for some time there may be signs of inflammation, such as redness and edema. The onset of the strangulation is

* Figure 3 appeared in the January installment, p. 180.

likely to have been sudden; it not infrequently follows straining of some sort that increases the intra-abdominal pressure; but at times no such history is obtained. In cases where the strangulation is complete, the pain may be severe in character from the onset.

Four case histories illustrating different types of strangulated external hernia follow:

CASE XX. *Obstruction by strangulated right inguinal hernia.*

No. 247849, M. G. H. Male, aged twenty-six. The patient gave a history of having had a right inguinal hernia, always easily reducible, for ten years. For the past four years he had worn a truss. Four hours before admission he was taken with a sharp pain in the right inguinal region; the pain has been constant and there has been no movement of the bowel since its onset. Patient noticed that the hernia was down in the sac, and he has not been able to reduce it.

Examination showed an irreducible, tender mass in the right inguinal region, having the typical characteristics of a strangulated hernia.

The patient was operated on under novocaine and ether anesthesia. When the sac was opened, the gut was found to be blue-black in color, but the circulation improved under observation. The intestine was considered definitely viable and was returned to the abdomen; the hernia was repaired. Convalescence was uneventful.

Comment: This is a rather typical case of strangulated hernia. The diagnosis is easy and if operation is promptly performed the result is usually satisfactory. Most of these cases can be handled under novocaine anesthesia.

While the diagnosis of a strangulated hernia is usually obvious both to the patient and to the physician, there are times when a small hernial mass may be overlooked. This is particularly true in regard to a small knuckle of bowel in a femoral hernia. The two following histories illustrate this type of case:

CASE XXI. No. 266491. Female, aged 73. The patient had had pain for four or five days before admission. No coherent history could be obtained. On a previous admission to the medical wards a diagnosis of arteriosclerosis and cholelithiasis had been made but no operation advised. On the present admission a diagnosis of intestinal obstruction was made; no hernia was found on physical examination.

Laparotomy showed a dilated intestine which when followed down led to a strangulated loop in the left femoral canal. The bowel was reduced and found to be viable. The patient also had a gallstone impacted in the

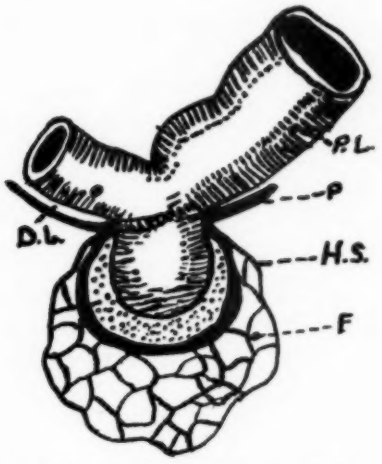

FIG. 36. A Richter's hernia shown in diagrammatic form. It will be noted that only a portion of the bowel wall is contained in the hernial sac and that the lumen of the intestine is not completely obstructed. (*After Walton.*[4]) P.L., Proximal dilated loop of gut. P., Peritoneum. H.S., Hernial sac. F., Wall of sac loaded with fat. D.L., Distal contracted loop of gut.

cystic duct. After a stormy convalescence the patient was discharged, relieved.

Comment: The cholelithiasis undoubtedly obscured the picture of obstruction, and the small femoral hernia was overlooked before operation.

CASE XXII. *Obstruction by Richter's hernia.*

No. 290977, M. G. H. Male, aged fifty-nine. The patient was taken with severe pain in the right lower quadrant of the abdomen eight days before admission; there was vomiting at that time. The pain and vomiting ceased within forty-eight hours of their onset; but constipation persisted, little or no results being obtained by enemas. The past history was negative, except for the fact that the patient had been jaundiced since childhood. Twenty years before admission he had received treatment for syphilis.

Physical examination of the abdomen showed a large, firm mass occupying most of the left side of the abdomen; the mass descended on inspiration. This mass had the characteristics of an enlarged spleen. During observation in the hospital the signs of obstruction increased and vomiting was profuse.

An exploratory laparotomy was carried out under novocaine anesthesia. In addition to the enlarged spleen, dilated and collapsed bowel was found. On following down one of the collapsed coils it was found that it entered the

right femoral ring. The hernial sac was then exposed in the right groin and it was found that a portion of the circumference of the bowel was constricted at the hernial ring, Richter's type of hernia (see Fig. 36). The strangulated portion of the bowel was necrotic, and when the sac was opened there was an escape of fecal material. A catheter was inserted into the bowel and held in place by purse-string sutures.

The patient recovered after a somewhat stormy convalescence. At the time of discharge from the hospital it was understood that he was to return later for a splenectomy.

Comment: The foregoing case represented a difficult diagnostic problem. The patient had chronic jaundice with splenomegaly, and the fact that he also had a strangulated Richter's hernia was entirely overlooked before operation. This case illustrates the importance of careful examination of all the usual hernial openings in any case showing symptoms of obstruction.

The accidental escape of contents from a necrotic bowel, such as occurred in this case, is extremely serious and very frequently leads to a fatal outcome from a virulent peritonitis. In another case of Richter's hernia, where this accident occurred, the patient died in a few days, the autopsy showing widespread gas bacillus infection, with emphysematous necrosis of the liver and spleen and extensive subcutaneous emphysema.

Occasionally a loop of bowel that has been damaged by interference with the circulation may be sufficiently viable, on being returned to the abdomen, so that no gangrene or perforation occurs, and yet so much scarring takes place that a stricture later results.[13] The following case illustrates this point:

CASE XXIII. *Strangulated inguinal hernia with subsequent stricture of the involved segment of bowel.*

No. 222859, M. G. H. Female, fifty seven years old. Three months before the present admission the patient had been operated upon for strangulated inguinal hernia: three inches of intestine that were strangulated in the sac had been very dark in color but had improved somewhat under observation and had been considered viable and returned to the abdominal cavity; the hernia had been repaired.

The patient returned with a history of increasing abdominal pain, nausea and vomiting. A diagnosis of intestinal obstruction was made and the abdomen explored. A stricture of the small intestine was located. This was resected and an anastomosis carried out. The patient made an uneventful recovery.

The pathological report on the section of bowel removed was as follows: "The specimen consists of a piece of small intestine 5 cm. long, whose surface is rough and red. The lumen is stenosed and admits the point of the scissors with some difficulty. The wall is thickened and fibrous. Microscopical sections from the central portion show the wall of the gut entirely destroyed by scar tissue. No mucosa remains, and the inner surface is formed by a connective tissue which contains focal collections of wandering phagocytes. Small collections of round cells are also present in the fibrous tissue. The peritoneal surface is highly vascular. It would seem probable that this scar tissue had been formed by the organization of blood clot which arose in the course of an infarction."

Comment: While the intestine was not injured so severely by strangulation in the inguinal hernia that necrosis followed, the wall of the gut was gradually converted into scar tissue which on further contraction produced the obstruction. This is an unusual late complication of strangulated hernia.

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Chapter X

VARIETIES OF OBSTRUCTION (Continued)

Obstruction by Occlusion of the Mesenteric Vessels

Occlusion of the larger mesenteric blood vessels is usually followed by acute intestinal obstruction, due to changes produced in the intestinal wall. It is open to question whether such obstructions should be classed with those of mechanical origin, since there is no blockage of the intestinal lumen, or with the functional obstructions. Since, however, there is an organic basis for the disease and since these obstructions are in certain instances subject to direct operative procedure, they are in this monograph placed among the mechanical obstructions.

The two lesions of most frequent occurrence are thrombosis (arterial or venous) and arterial embolism. In some cases both lesions are present, thrombosis following primary arterial embolism (Jackson, Porter and Quinby[1]). Among the cases of mesenteric occlusion in the recent Massachusetts General Hospital series,[2] there were six of mesenteric thrombosis and three in which the circulation was occluded in other ways. In one of these latter instances a carcinoma arising in the sigmoid had extended around the inferior mesenteric artery, completely occluding the artery and resulting in hemorrhagic infarction of the area of colon supplied by this vessel. In another instance, a group of enlarged glands of metastatic origin had pressed on the superior mesenteric artery and produced intestinal infarction. In the third instance, arteriosclerotic changes in branches of the superior mesenteric artery had been so extensive as to result in the hemorrhagic infarction of the segment of ileum which they supplied.

Etiology. The diseases which lead to the formation of thrombi or of emboli are of etiological significance for occlusions of the mesenteric vessels.[1,3,4] Among these may be

mentioned endocarditis, atheroma of the aorta, and arteriosclerosis, particularly of the mesenteric arteries. The embolus frequently arises from vegetation on the mitral or aortic valves; or dislodgment of a thrombus from the left auricle may occur. Occasionally an atheromatous patch in the aorta may be the source of an embolus. In the venous type of thrombosis, conditions causing stenosis in the portal system are of importance. The thrombus may be primarily in the mesenteric veins and ascend into the larger radicals; or the reverse process may take place. Infections, particularly suppurative conditions in the peritoneal cavity arising from the appendix, may be responsible for the thrombosis. Thrombosis of the mesenteric vessels may result from the trauma of volvulus, strangulated hernia, or intussusception. Cirrhosis, syphilis, pylophlebitis, etc., should be mentioned as causes of secondary or descending venous thrombi.

Pathology. In the cases analyzed by Jackson, Porter and Quinby,[1] the occlusion was arterial in 61 per cent, venous in 39 per cent. The changes produced in the bowel by the occlusion of an important mesenteric vessel are various: they are influenced by a number of factors, of which the more outstanding are the size of the vessel occluded, the rapidity with which the interruption of the circulation takes place and the adequacy of the collateral circulation. If the blood supply to a considerable segment of intestine is suddenly interrupted by the occlusion of an artery, a hemorrhagic infarct usually results. Welch et al.[5] have established the fact that this is due not to the regurgitation of blood from the veins, as had previously been thought, but to the entrance of blood through the capillaries from collateral arterial circulation. Rarely, an anemic infarct follows obstruction of a mesenteric artery (2 per cent in Trotter's series[6]). For a comprehensive discussion of the mechanism of infarction, the work of Welch[5] should be consulted. The mesentery itself becomes edematous and congested; and bloody fluid is usually present in the peritoneal cavity. Degenerative changes in the affected segment of bowel

may vary from congestion, edema and other inflammatory reactions, to complete infarction, necrosis and perforation. Klein's[3] article gives a comprehensive and interesting discussion of the varied pathological pictures that may be produced by vascular lesions of the mesentery; as this author points out, occlusion even of the superior mesenteric artery may at times take place without fatal consequences. (See also case reports by Ross[7] and Reed,[8] where spontaneous recovery took place.)

AGE AND SEX. Sixty-four per cent of the cases of Jackson, Porter and Quinby[1] occurred in men, 36 per cent in women. The ages of the patients are shown as follows:

Age (years)	Per Cent
10 to 19	4
20 to 29	12
30 to 39	16
40 to 49	22
50 to 59	18
60 to 69	15
70 to 79	8
80 to 89	3
90 to 99	2

It will be noted that mesenteric occlusion is largely a disease of middle or old age, although cases are occasionally met with in the young.

COURSE OF THE DISEASE. As would be expected from the varied pathological pictures presented by this disease, the clinical manifestations are also varied, the course of the illness depending upon the extent of the thrombosis and the ability to establish adequate collateral circulation. Jackson, Porter and Quinby divide their cases into two groups: those which run an acute course, and those which run a chronic course. The first group is much the larger. In these cases there may be a sudden onset of the colicky pain characteristic of obstruction, often at a time when the patient is in good health. Unless the condition is relieved, death usually follows in a few days or even hours, although occasionally recovery may take place even when the symptoms have been acute and severe (Klein[3]

Ross,[7] Reed.[8]) The pain is usually generalized over the abdomen; it may be constant and extremely severe, although not infrequently there are exacerbations with comparative comfort between attacks. Vomiting is a very common symptom and if the infarcted area is high in the intestinal tract the vomitus may contain blood. If there is any passage of stools they are very likely to contain blood; Jackson, Porter and Quinby found blood in the stools in 41 per cent of their cases. There may be an absence of bowel movements from the onset of the attack; or there may be a number of bloody movements, followed by constipation. Distention comes on early and may be severe. The abdomen is usually tender. The temperature is likely to be nearly normal, although in the fulminating cases it may be subnormal. A marked increase in the white blood cells is a rather characteristic finding in the disease.[4]

The group of cases which run a chronic course is smaller. The onset of these cases is insidious. They may go on to a spontaneous cure.[1]

The following is an illustrative case of mesenteric thrombosis:

CASE XXIV. *Obstruction by mesenteric thrombosis.*

No. 269,845, M. G. H. Male, aged fifty-nine. He had been operated upon for cholelithiasis ten years before, and since that time had had intermittent attacks of abdominal pain. On admission the patient stated that he had suffered during the past month from attacks of generalized abdominal pain. He had vomited three days before entrance, but this had not been repeated. There had been no bowel movement for the past six days. On physical examination the abdomen was found to be distended and somewhat tender. No masses were palpated and no peristalsis could be seen or heard. The temperature was 100.2°F., pulse 126, white blood count 22,000.

The patient was in poor condition before operation.

The operation was carried out under ether anesthesia. The peritoneal cavity contained bloody fluid. An infarction of 1½ feet of the upper jejunum was found; the mesentery was thickened and edematous. The gangrenous segment of small intestine was resected. The patient died on the table.

The following is an abstract of a case reported by Ross[7]:

CASE XXV. *Obstruction by mesenteric thrombosis; verification at operation; recovery without resection.*

Case No. v. D. H. G. Male, fifty-one years of age. The day before admission the patient was suddenly taken with severe epigastric pain, which in the course of an hour or two became generalized. The pain was paroxysmal in character, leaving the patient with a dull ache between paroxysms. He vomited several times; the bowels did not move after the beginning of the illness. Past history negative.

Examination of the abdomen showed little or no distention. Exaggerated peristalsis could be heard on auscultation. White blood count 13,000; 76 per cent polymorphonuclears. Enema without result. Lavage showed gastric contents with fecal odor.

Patient was operated on under the diagnosis of intestinal obstruction. At operation a thrombosis was found involving a branch of the superior mesenteric artery which supplied a segment of ileum. There was considerable hemorrhage into the mesentery and a small amount of free blood in the abdominal cavity. The segment of bowel affected was in fair condition, apparently being taken care of by the collateral circulation. It was decided that resection was not necessary, and the abdomen was closed.

The patient was discharged in good condition on the fourteenth day after operation.

Comment. This case illustrates the point made in the text: that occasionally a mesenteric thrombosis may occur and yet the collateral circulation be sufficient to maintain the viability of the bowel.

The next case is quoted from an article by Jackson, Porter and Quinby[1]:

CASE XXVI. *Obstruction by mesenteric thrombosis.*

No. 14. Male, aged sixty-four. Three days before admission the patient was seized with sudden, severe pain in the abdomen, somewhat to the right of the umbilicus; diarrhea but no vomiting at the onset. Since yesterday there had been constant abdominal pain with increasing distention. There has been persistent nausea with vomiting, and no bowel movements for two days.

Physical examination showed a fairly well-developed and nourished man; temperature 100°F., pulse 80, respirations 23, white blood count 24,000. The abdomen was distended and there was some tenderness, especially in the region of the umbilicus.

The patient was operated upon. A large quantity of free, clear fluid was found (culture sterile). A loop of obstructed bowel was located which was dark red in color with here and there bright yellowish-green mottlings

about ¾ inch in diameter, covered with thick fibrin. The mesentery attached to this loop of bowel was of fair color, thickened, but bled scarcely at all when incised. The gangrenous loop, which showed a sharp line of demarcation, was resected and an end-to-end anastomosis was carried out. Examination of the resected loop showed that the mesenteric artery and vein were filled with a more or less adherent thrombosis, especially so in the artery, the inner coat of which was proliferated.

The general condition of the patient appeared improved following the operation; but there was soon a recurrence of the previous symptoms, marked distention of the abdomen, and no movement of the bowels or passage of gas could be obtained. The patient died three days after operation. Autopsy showed that further thrombosis, and gangrene in the bowel proximal to the anastomosis, had taken place.

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The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIAL

SINCE the organization of the Southern Surgical Association in 1887 the one regular medium of distribution for the splendid scientific papers read before the Association has been its volume of Transactions. While this volume of Transactions has gone to most of the big libraries of this continent and Europe yet the actual distribution, including libraries and membership, has never exceeded three hundred copies.

For a long time there has been an insistent demand by the profession at large for a wider distribution of and more ready

accessibility to the Scientific Proceedings of the Southern Surgical Association.

Four years ago the Association passed a resolution requesting the Council to enter into negotiation with certain medical publishing houses with the idea of providing for a wider distribution of the scientific proceedings than afforded by the volume of Transactions. The Council has given this matter most serious and thoughtful consideration. Comparison of similar arrangements by other scientific bodies together with repeated studies of estimates offered by several of the leading medical publishing companies was made. This was not a problem to be consummated in a short period of time and the Council has labored arduously and deliberated most carefully in reaching a decision.

At the recent meeting of the Southern Surgical Association in Miami, Florida, the Council recommended to the Southern Surgical Association that contract be entered into with The American Journal of Surgery by which the scientific proceedings would be published in the May and June numbers of The American Journal of Surgery and in addition that the Transactions, as heretofore issued, would be published under the same contract. This means that the scientific papers and discussions presented at the meetings of the Southern Surgical Association will in the future have a distribution of thousands among the subscribers to The American Journal of Surgery. The style, size, binding and general format of the volume of Transactions has remained the same since the organization of the Association in 1887 and the identical type of volume will continue to be issued under the new contract with Paul B. Hoeber, Inc.

The fellowship of the Southern Surgical Association extends from the east to the west coast and from the far north to the far south of the United States. It is a strictly scientific and hard working surgical organization with a program limited to forty papers at each meeting. Aside from the scientific aspect there is an atmosphere at the meetings and among its Fellows of

close personal friendship and in addition a social charm both intriguing and unique such as the writer has never seen in any other body. In familiar circles the members are often spoken of as "D Fs." Now, the letters D F could represent several appropriate appelations, but in the Southland and wherever the real spirit of the Southern Surgical Association is known these letters stand for Distinguished Family.

In behalf of the Council and the Fellows of the Southern Surgical Association it would be no more than appropriate for me to felicitate The American Journal of Surgery on the consummation of this contract with the Southern Surgical Association and to give them a true Southern welcome into the inner circle of the Distinguished Family.

R. L. PAYNE.

PRESIDENTIAL ADDRESS

SURGERY AND ITS RELATION TO SOCIETY

R. S. CATHCART, M.D., F.A.C.S.

CHARLESTON, S. C.

Fellows of the Southern Surgical Association and guests:

To be President of the Southern Surgical Association is indeed a distinction and I count it an honor to have been selected to preside over your deliberations this year.

This evening, as I stand before this audience, my remarks perforce will be inadequate. However, I do want you to know that my professional life has been guided through the years by principles laid down and practiced within this Association. I am indebted to you for pleasant memories and many friendships.

It is said that organizations and communities differ just as do individuals, that just as there is a dominant note in the life of every individual, so is there a dominant note in the life of every community and every organization. For instance, ancient Tyre was a city of commerce—it cared for the bodies of men; ancient Athens was a city of learning—it cared for the minds of men; ancient Jerusalem was a city of religion—it cared for the souls of men. If I were called upon, this evening, to name the dominant note in the life of our Southern Surgical Association, I would say unhesitatingly that it was character. Horace Greeley, at the close of a stormy career, exclaimed: "Fame is but a vapor, popularity an accident. Character is the only thing that endures."

I have had the privilege of being a member of this distinguished Association for thirty-three years, and during that time have observed great changes, especially in the realm of surgery, so I have chosen "Surgery and Its Relation to Society" as my subject for this evening.

Discoveries in the scientific world have revolutionized surgical methods in many ways. The world is in a crucible.

From the tests lately made by the World War and by the period of rehabilitation, a surgery has evolved which changes many procedures heretofore looked upon as perfect. It is not my purpose to go extensively into the past history of surgery but I shall consider the main problems men have met through the ages, and emphasize those which are before us today.

Centuries ago, dating back to 5702 B.C. (Boeckh), the Egyptians practiced surgery and recorded their work. In a few instances we find surgeons occupying high and influential positions. Athotis, an Egyptian king, practiced medicine and wrote a book on anatomy. Also we find in Egypt a record of intelligent cooperation among men in behalf of medicine. We learn from Alfred Brown, writing of the military surgeon of that period:

> He must see to the food, water, wood and places of encampment and examine them carefully for they may be poisoned by the enemy. . . . His tent shall be near the King's tent and he shall have his books and drugs at hand. There shall be a flag over his tent that the sick, poisoned and wounded may find him quickly.

This is the basis of our present military medical regulations.

The mysticism, which held such an important place in the lives of the ancients, hampered the surgeons of the past. Throughout the world there was a long period of time when surgeons suffered ignominy, and it is to the credit of those pioneers of surgery, whose indomitable wills compelled recognition for themselves, that we have the privileges accorded us today.

From the last of the nineteenth through the early part of the twentieth century, London and the celebrated resort, Bath, became the centers of pretentious medical quacks from all parts of Europe. They found a fertile field among the fashionable of England and these quacks established a prestige by their wiles and guiles, airs and insincerities. They were the exponents of the foppery which saturated London and Bath. With their wigs, gold headed canes, gold shoe buckles, lace frills and parti-colored clothes, they commanded a large

following. This quackery prevailed for a long time in England, then spread throughout Europe and gradually found productive fields in America.

Today the effects are still in evidence and now quackery may be divided into several groups: First, there is a class of commercial advertising men, found outside the realm of the medical profession. The second class contains the doctor who practices his tricks under the guise and protectorate of the medical profession. The third class is typified by the doctor who makes an extravagant promise of "cure" to his patient while posing as a reputable and qualified man of science. He attends dinners and numerous social functions; belongs to exclusive clubs and maintains luxurious offices and automobiles; he asks for payment of fees in advance and carries on his medical work as a commercial enterprise rather than as a profession. There are at the present time numerous examples of this class to be found in good standing within medical circles and organizations. They are only hoodwinking the people in a more elegant and effective manner than the unvarnished quack.

There is a fourth class composed of men more or less the victims of circumstance. These lack a high degree of moral stamina. It is a common occurrence for the smart set in different communities to make one doctor the vogue. There are various ways in which this has been accomplished. The doctor selected may have married a rich girl of this group, or he may play a good game of bridge or golf, dance "divinely," or have a "delightful way" with the ladies; he may be a handsome man, a polished conversationalist and possess all the social qualities necessary for popularity. Such a person often gains a large practice, crowds his waiting room with the "fashionables," whose imaginary ailments he encourages in order to enlarge his bank account. His professional ability is often mediocre and his skill insufficient.

What is true of medicine may also apply to surgery. Fashionable groups create operative hobbies. They organize "appendix clubs" and "tonsil clubs" and carry their trophies

around in little bottles for exhibition. Singing the praises of their doctor becomes with them an hysterical occupation. Making straight noses out of normally crooked ones, face lifting, "slenderizing" figures with fat reducing diets, prescribing "rest cures" for "nervous prosperity," are practices carried on in wealthy centers.

Surgeons who knowingly perform unnecessary operations are dishonest, for "Operative surgery is a science of entering the living body to relieve an abnormal state which can be relieved in no other way, or to remove offending diseased tissues which are not necessary to continued life and which jeopardize it." When this thought is burned into the conscious mind of every surgeon unnecessary operations will become unknown.

Not long ago I heard of a woman who needed an operation. When asked her choice of a surgeon she remarked, "Doctor So-and-So is going to do it." Her friend said: "I did not know he was a surgeon." "Well, he isn't, yet," replied the lady, "But he has to begin his work on some one." How long will society choose surgeons "because they have to begin their work on some one"? Another man admits he has not selected a recognized surgeon! He chose Doctor X for an appendectomy because he charged only twenty-five dollars.

These stories bring to mind one of the most important and far-reaching changes taking place in the surgical profession today: the increased demand for competency of those who desire to practice surgery. This demand is being made by some of the profession, and to a small degree by the public. Some of the medical schools are taking cognizance of this. All of them should adopt at once means with which to meet this demand in order that it may continue to grow.

The latest movement on foot is that a plan be generally adopted for the teaching of medicine whereby the medical schools will devote four years to the teaching of the fundamentals of medicine, after which time one year of rotating service in a general hospital will be required, before a degree will be

granted. At the end of this five year period a man or woman would then be eligible to practice general medicine.

Should a doctor desire to specialize in one branch he shall be required to serve from three to five years in that particular line before he shall be recognized by the profession and be known to the public as a specialist. Some of the state boards and colleges already require one year of hospital service. Some of the national societies have both of these requirements for membership. If other medical colleges and societies were to adopt this plan there would be fewer poorly trained men in the various specialties and better results would ensue. Once this has been accomplished within the profession, the public can easily be made to see its value and demand that state laws be passed accordingly for their protection.

It will be claimed by some that ten years of preparation for specialization will place one in his work at too late a period in life. This is erroneous because a larger percentage of doctors achieve success who have served in this way and who have commenced practice at a later period in life.

The question of expense involved need not be a problem. The opportunity for a doctor to equip himself for special work is already offered. A doctor may be a resident at a hospital, may obtain a fellowship at a clinic or he may become an assistant to some recognized specialist. In all of these positions a man is earning a living. He is not amassing a fortune during that time, but he is more wisely planning for the future. As the need for such places grows, the supply will increase.

To perfect this plan a thorough survey of the grammar, high and academic schools should be made with the view of eliminating the overlapping of subjects. Preliminary education should not be decreased but a consolidation should be made which will enable a man to enter a medical school at an earlier age.

The effect that surgery has had on social conditions during the past twenty years has been far reaching. Surgery of the chest hardly existed twenty years ago and now it is in a well-advanced stage of development. Considerable progress has been

made by means of surgery in the treatment of tuberculosis of the lung. This is effected by the collapse therapy of pneumothorax, phrenic nerve exairesis, and thoracoplasty. Even lobectomy is accomplished with a fair degree of success. Roentgenology, ventriculography and electrosurgery have made possible the remarkable development of surgery of the brain.

Gastric surgery is upon a much sounder physiological basis, and the results are proportionately satisfactory. Surgery of the sympathetic system, which is comparatively recent and in its early developmental stage, gives promise of value in certain conditions.

The advance in anesthesia contributes largely to the success of surgery. Although ether remains the most generally used anesthetic and is the basis for judging others, yet nitrous oxide and ethylene have replaced it to a great extent in cases where a lighter anesthesia is all that is required. The development of the non-toxic novocaine opened the way for remarkable progress in the field of local and regional anesthesia. Spinal anesthesia is a new attainment and its advantages in certain restricted fields are well established. However, there is still a great deal that we do not know about it. The so-called "balanced anesthesia" consisting of combinations of various anesthetics is used with good results.

Many thousands of dollars have been given for research in the cancer field. The true cause of malignancy has not been found and there is little doubt but that this must be discovered before the disease can be mastered. This is one of the most serious questions facing humanity today. The world-wide study and research given the subject have been extensive. The most valuable contributions to surgery have come from the biological laboratories, therefore it is not hard to appreciate the fact that surgery looks more and more to the vigorous sciences of biochemistry and physiology for solution. Radium and *x*-ray have distinct influence and are a great benefit in some cases. However, at the present time the only opportunity for the

cure of malignancy continues to be by a complete removal of the growth. People now are becoming "cancer conscious" and as a result they are coming to operation earlier and the number of five year cures is increasing steadily.

It is interesting to record that some pathological conditions have been removed from surgery which heretofore were considered strictly within its sphere, and others added which previously were not included. Also as surgical thinking has become general we notice a remarkable difference in the attitude of mankind toward operative work. We now get the major portion of our patients when surgery will be effective and not a last resort.

What about the present upheaval and the future of surgery? Surgery is affected by and participates in the constantly changing social order. With every change there are always some professional men who are alarmed at the possible dangers confronting the fundamentals of the practice of medicine. The attitude of society toward the surgeon and the attitude of the surgeon toward society is crystallizing in a new form, and many members of the profession are seriously thoughtful over certain phases of the situation. While the course of medicine has suffered setbacks in the past and may suffer them again, the fact remains that advancement has been made and the belief is that it will continue to be made. We may be assured that ultimately the greatest good to the greatest number will result, even though it is not outside the realm of possibility that a period of chaos will intervene.

The manner in which the social relations of medicine evolve is largely within the guidance of the profession. Should it pursue with arrogance a course which ignores the public interest and which demands the preservation of present conditions, without doubt the control of medical matters will be taken from the profession. On the other hand, if it pursues with humility a course which will develop the best interests of humanity, it is a certainty that the fundamentals of scientific and ethical medicine will be preserved and the profession will

be allowed to govern its growth. The main danger seems to come from a stubborn ignoring of public interest in medical matters, and from a desire by the public for change in the course as pursued up to the present in the practice of medicine. Just how strong these sentiments may be or how they grow is not at all clear but the rumblings are heard.

It is not to be contemplated that the profession is able to sit down and outline a program satisfying the conditions now existing or likely to exist at any given time. Neither is it reasonable to suppose that any group or body of people could settle in a finished program its manner of participation in a changing order. It must be realized that while the steps of progress are unhesitating, they are also slow, deliberate and painful.

Despite the outcry against the encroachment of governmental direction in major affairs, we are apparently entering an era of socialization with governmental control of most or all activities. The profession has developed an antagonism to state medicine in general. What they should fear is the political control in some forms of state medicine which may cause the loss of individual incentive and of the personality phase in medical proficiency and practice. Some even fear that a loss in income may be involved. This may be justified on their part but not from the standpoint of the profession as a whole. It is against the best traditions of medicine to lay emphasis on remuneration. The aim of medicine must be always to give the best service. If such service is rendered, financial reward will necessarily follow.

The socialization of medicine and state medicine are phrases which are interpreted according to individual interests. To condemn and attack all forms of socialized medicine is a poor policy. It is flinging a challenge to the trend of the times and that challenge will certainly be accepted. We already have a measure of state medicine and it has been proved to be for the good of humanity as well as of medicine. We will have a greater measure of this for its natural growth cannot be stopped. It is our duty to direct it in the right channels.

Any form of state medicine, including hospitals, should be entirely out of politics, because it is a fact that bequests are not made to organizations which are in any way controlled by politics. In the majority of institutions it is necessary to receive aid from philanthropists from time to time. Again, it will be extremely difficult to secure the best surgical service for people at large if such service is selected by political preferment rather than professional competency. Appointments of this kind will be obliged to have a deleterious effect on surgery. It will be difficult to maintain standards if the present trend of state medicine is followed.

Scientific research is necessary for the progress of medicine and the incentive for such work is generally lacking in medicine under governmental control. The younger men should encourage the development of this field.

The World War brought into being an important question: the care of its veterans. This question effects society and the profession. Some of these men are ill and the profession is anxious and able to care for them. We already have civilian hospitals where veterans at a minimum charge may be cared for with excellent medical and surgical attention. In spite of this the government is building and equipping hospitals and manning them with political appointees. It could provide for the care of these men in the existing civilian hospitals and still be defraying part of the debt owed to those who gave their health in behalf of their country. If the government fears that with increased work skilled care may be lost, it could also pay for the services rendered by the doctors who heretofore have worked without remuneration. It could even furnish a selected personnel to attend the veterans in the civilian hospitals as is done in many instances today, for example, in the United States Public Health Service. Should the civilian hospitals in some communities prove too small, they may be enlarged at less expense to the government. This would employ men in other lines within their communities. Why should the government produce over-hospitalization? Why should it seek to

solve this problem in the most expensive way? To care for each veteran in his community seems to be the most efficient and practical solution. This question is being handled by a committee from the American Medical Association and the efforts of this Committee combined with the American Legion and the American Hospital Association should result in a policy satisfactory to all.

Through this period where the masses are acutely conscious and well organized it should be remembered that surgery and its relation to society is ever changing but that the ideals promulgated by the Southern Surgical Association are constant. Whatever re-adjustment may be made there will still be these ideals toward which the younger generations of surgeons may strive, and in striving, so mould their characters; that society as it then will be constituted, will honor and revere their names.

URETERAL CALCULI

GEORGE R. LIVERMORE, M.D., F.A.C.S.

MEMPHIS, TENN.

IT is the generally accepted belief that ureteral calculi are formed in the kidney, then pass down the ureter. Hunner,[1] however, believes that calculi are formed primarily in the ureter, due to stasis and infection, the result of stricture of the ureter. It is unquestionably true that stasis and infection play leading roles in the formation of ureteral calculi, but that stricture of the ureter is the sole cause is a statement that most of us are unwilling to accept.

There are many theories as to the cause of urinary calculi, none of which, however, is universally accepted. The urine is a solution of crystalline material, and the crystalline material is said to be held in solution by certain constituents called colloids. It is upon this that Spitzer and Hillkowitz[2] build their colloidal theory as to the causation of urinary calculi.

The old idea of a nucleus or nidus being necessary for the formation of a calculus, such as a foreign body, a blood clot, a clump of pus, or bacteria still holds true, and the colloidal theory fits in well with it, as its advocates claim that when the colloids of the urine coagulate, they no longer hold the crystalline matter in solution, but themselves in the coagulated state form a network, upon which the crystalline material is deposited. It is also claimed that the crystalline matter may act as the nucleus and alternate layers of crystals and colloids may be deposited to form a calculus. Clumps of bacteria, too, may act as a nucleus, upon which crystals and colloids may deposit.

The work of Keyser,[3] and Rosenow and Meisser[4] has conclusively proved the predilection of certain strains of bacteria to the formation of calculi. Eisendrath and Rolnick[5] state that colon and salmonella bacilli cause precipitation of

the normal colloids of the urine. One of the newer theories, a diet deficient in vitamins A and D, has recently been advanced and the feeding of such a diet to rats has been followed by the formation of calculi in both the kidneys and the bladder. This has been confirmed by Dr. A. R. Bliss in the laboratory of the University of Tennessee. In addition to the foregoing, stasis and faulty metabolism must be considered as etiological factors in the formation of urinary calculi. The triad: infection, stasis and faulty metabolism was given as the author's theory as to the causation of urinary calculi in a paper[6] read before the section on Urology of the Southern Medical Association, November, 1924.

If the colon and salmonella bacilli cause precipitation of the normal colloids of the urine, as reported by Eisendrath and Rolnick,[5] perhaps other bacteria, under varying conditions, may produce the same result. Therefore, the colloidal theory further substantiates the author's contention that infection, stasis and faulty metabolism are the chief factors in the etiology of urinary calculi.

SYMPTOMS

The symptoms of ureteral calculi vary according to the character of the obstruction, the degree of infection and the condition of the kidney. Eisendrath and Rolnick[5] give six different clinical types, viz., (1) those with predominant symptoms of renal infection with or without a history of pain or colic; (2) those in which pain is the outstanding feature; (3) those in which anuria is predominant; (4) those presenting evidence of non-infected hydronephrosis; (5) those in which a hematuria or pyuria without localizing signs is present; (6) those presenting no symptoms or latent cases.

By far the most frequent symptom of ureteral calculus is pain, and this usually of a colicky character with radiation to the groin, testicles or glans penis in the male, to the labia in the female. Nausea and vomiting are present, especially

when the pain is colicky. Blood, pus, albumin and bacteria may be found in the urine. Often the pus and blood cells are so few as to be considered of no consequence and although by no means can they be called a pathognomonic sign of calculus, in conjunction with the other symptoms and signs they should lead to a correct diagnosis.

In cases with marked obstruction there may be symptoms of pyelonephritis: chills, fever and sweats, a high leucocyte count and a high polymorphonuclear percentage; and when the stone is impacted, in addition to the foregoing, there may be complete anuria, obstructive on the affected side and reflex on the other or obstructive on both sides. In other cases, even though there is pus in the urine, there are little or no symptoms of infection.

The differential diagnosis from disease of the gall bladder, appendix, colon and female pelvic organs is at times not easy and it is here that cystoscopy and *x*-ray prove so invaluable. Often a shadow in the line of the ureter may be interpreted as a stone when stereoscopic films will prove it to be behind or in front of the ureter. Kretschmer[7] suggested the making of two exposures on the same film, with a shift of the *x*-ray tube, with the catheters in position as a means of proving a shadow in the ureter, and Bransford Lewis[8] made it still more accurate by substituting a metal flexible instrument for the ureteral catheter. The sensation of obstruction to the passage of the ureteral catheter is not pathognomonic for often the catheter passes the calculus without the least sense of obstruction. Scratches on the wax tipped catheter are helpful, but great care must be exercised to be sure they are made by the stone.

Intravenous urography is one of the newer aids in clearing up the diagnosis, especially in calculi that do not cast a shadow on the *x*-ray plate, and the injection of pyelographic media into the pelvis and ureter often makes visible a calculus that would otherwise be overlooked. Oxygen urograms are especially valuable in such cases and although air injections have proved

dangerous (Thompson's[9] series of cases without mishap seems to disprove this) no harm has resulted when oxygen was used.

TREATMENT

The treatment of ureteral calculi depends upon (1) the size, (2) the number, (3) the location, (4) the condition of the patient and (5) the functional capacity of the kidneys.

(1) With a calculus of 0.5 to 0.75 cm. in diameter, every effort should be made to assist its passage down the ureter.

(2) Multiple calculi are much more difficult to pass than single ones, but it is remarkable what can be accomplished by care, patience and persistence.

(3) Calculi near the bladder are more easily freed than those higher up. They are more accessible to instrumentation and there is less danger of injury to the ureter in dislodging them. Stones in the lower ureter will as a rule pass to the bladder; although when lodged and constantly added to, they may grow to a size that makes their further progress impossible.

(4) The condition of the patient must be considered first, and if grave the method that offers the quickest and safest relief from the constitutional symptoms, with the minimum of shock, regardless of whether the stone is removed or not, should be the method of choice.

(5) The condition of the kidneys. Here, too, the same considerations as just stated should govern the method of treatment. I am a firm believer in the cystoscopic removal of ureteral calculi, and think every effort should be made to relieve the patient in this way, when the size of the calculus and the condition of the kidneys and the patient justify it.

Some years ago I devised a ureteral stone dislodger and later a ureteral dilator, both of which have proved of great value in assisting patients to pass ureteral calculi. (See Figs. 1 and 2.) The method as used by the author consists in first ascertaining the functional capacity of each kidney. If at the first attempt we are unable to pass a catheter beyond the

stone in order to make a phenolsulphonphthalein test and the patient's condition justifies further instrumentation, we pass catheters, bougies and the Livermore dilator to the stone

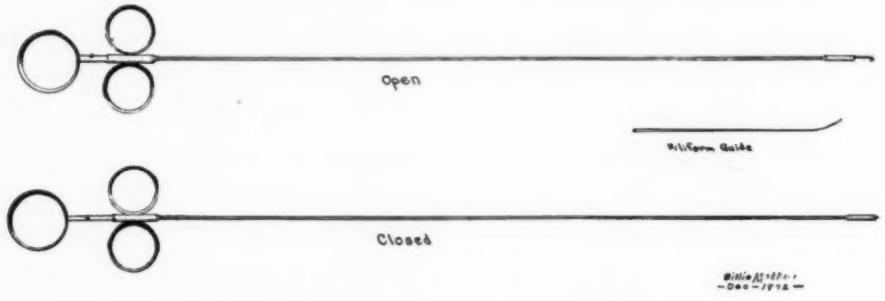

FIG. 1. Livermore ureteral stone dislodger.

and by thus dilating the ureter below the stone, hope to cause its passage. Frequently the stone will pass after one such treatment. In those cases where the stone is adherent to the mucous membrane due to spicules or irregularities on the stone or is embedded in the mucosa, it may sometimes be freed with the Livermore stone dislodger.

If, however, the patient's condition is poor, then operation should be done at once. I have never seen any special benefit

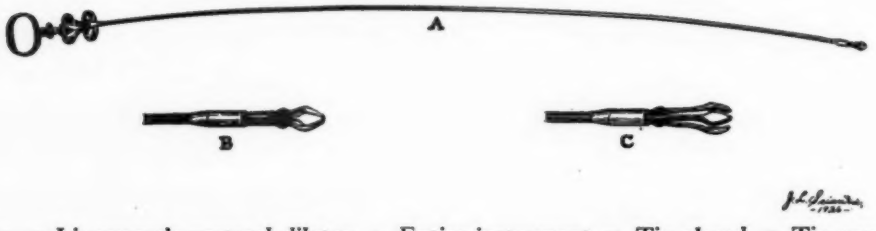

FIG. 2. Livermore's ureteral dilator. A. Entire instrument. B. Tip closed. C. Tip open.

from the injection of sterile olive oil. If the stone does not pass in a week, and the patient has no untoward symptoms, we again attempt to pass a bougie or a catheter, preferably one with a filiform tip (a Blassucci), beyond the stone and in the majority of cases are successful. A functional test is now made, and if the kidney function is good, the catheter is left in and with drainage established and the back pressure on the kidney

relieved, we now feel safe in prolonging our cystoscopic manipulations as long as the condition of the patient will permit. You doubtless know that there are some patients who are intolerant to cystoscopic manipulations and whose reactions to them are rather severe. The intravenous injection of hexamethylenamine tetramine gr. xxxi, given when the treatment is finished, often prevents reactions and given twice a day diminishes their severity after they have occurred. In patients of this type, operation must be done at once. After succeeding in passing one catheter beyond the calculus and leaving it in for several days, we are frequently able to pass one or more catheters beyond the stone by the side of the one passed at the first treatment. The progress of the stone may be noted by repeated *x*-ray films. Dilating the ureter below the stone with the Livermore, Walther or Dourmaskin dilator aids materially in assisting its passage to the bladder. When the stone reaches the intramural portion of the ureter, it is often held there and no amount of dilatation will cause it to enter the bladder. Fulguration of the edema about the orifice, or better still, meatotomy with the Neil Moore electrode, or with the Bumpus scissors after fulguration along the line of incision allows it to pass into the bladder. We have used the cutting current (of the McCarthy unit for prostatic resection) with excellent results and no hemorrhage in performing meatotomy for the removal of stones near the ureteral meatus.

The twisting of three or more catheters about the stone followed by gentle pulling on the catheters as suggested by Bumpus[9] will often dislodge the calculus and deliver it into the bladder. How long can cystoscopic manipulations be continued? Our guide is the functional output of the kidneys and the reaction of the patient. If the function of the kidney remains good, we can continue our attempts at removal, provided the condition of the patient is satisfactory. When the kidney function begins to fail and the catheter drainage does not restore it, then the stone should be removed by operation. It is a fact in some cases that the obstructing calculus has

produced so much back pressure on the kidney that there may be no excretion of phenolsulphonephthalein, when the catheter is first passed beyond the stone. We must not jump to a hasty conclusion that such a kidney is hopeless for often with continued drainage the function is restored to normal or nearly so.

In that type of case where we have stones in both ureters with symptoms of acute pyelonephritis—rigors, fever, sweats and perhaps anuria, usually a very ill patient, it is safest to attempt to pass a catheter beyond the stones to each pelvis and establish drainage which in the majority of cases will enable the patient to get in condition to stand an operation or else the dilation of the ureters will permit the stones to pass, thus bringing about the same result without operative interference.

A note of warning must be sounded, however, as to the danger of too prolonged attempts at cystoscopic removal of ureteral calculi, for if persisted in when the kidney function is failing or when catheter drainage does not cause the prompt subsidence of rigors and fever or in that type where we are unable to pass a catheter or bougie beyond the stone, there is grave danger of causing destruction of the kidney and perhaps the death of the patient. It has long been recognized that patients with chronic kidney infections, provided their kidney function is fairly good, withstand acute attacks much better than those who have their first acute attacks. This is due to the fact that a certain amount of antibodies (opsonins) has been developed in fighting the chronic infection. These act as the first line of defense while a second or reserve force is being prepared. In addition the kidney has become somewhat fortified against back pressure and is more capable of protecting itself against it than the kidney which has never been subjected to it before. Such chronic cases often mask the seriousness of the true condition of the patient by their lack of grave symptoms.

I have recently had such a case in a man fifty-eight years of age, who has had chronic pyelonephritis for twenty-five years. He has been cystoscoped on an average of once a month during this entire time and as he is a traveling salesman, and covers nearly all the States in the Union, I feel sure he has been cystoscoped by practically every prominent urologist in all the large cities of the country. In the past five years he has developed calculi in both kidneys; three in the left, and two in the right. The function of both kidneys has remained remarkably good until the calculi developed, when with repeated ulceration, sloughing and profuse hematuria the function has been much impaired.

About six months ago one of the calculi in his left kidney pelvis entered the ureter and when I saw him about six weeks later was about midway from the kidney to the bladder. A catheter was easily passed by the side of the calculus to the pelvis of the left kidney and a large amount of pus and urine withdrawn. The function of the kidney, however, was about the same as when seen before the calculus began its descent. Following this treatment, he made an extensive trip and was as well as usual, although he had some pain in his left loin and repeated attacks of marked hematuria.

About two months ago he had an attack of left ureteral colic with rigors, high fever and sweats, a high leucocyte count and a high polymorphonuclear percentage. Under catheter drainage in another city he had a stormy convalescence, being both septic and uremic, but in two weeks his temperature was normal and his output good, and remained so for four days when the retention catheter was removed. He again had rigors, fever and sweats, which promptly subsided when the ureteral catheter was replaced. An *x*-ray showed the stone lodged in the left ureter near the pelvic brim and too large to pass. His condition was too serious to admit of operation, so the catheter was left in for one week, when after five days of freedom from fever, it was removed. He had no fever for four days, then it rose to 100°F., was normal for four days, then 101°F., was normal one day, then for two days did not go above 100°F. The next day it reached 101°F. He had had no rigors or drenching sweats and no severe pain or tenderness since the catheter had been replaced the last time and none since its removal, and he had been sitting up in a chair on the days when his temperature was normal. The lower pole of the left kidney, which had been palpable for years, was now felt 2 inches below the free border of the ribs.

An attempt was made to replace the catheter, but it could not be passed beyond the stone. As his condition was so poor, I felt that a nephrostomy offered the best chance, and under gas and synergistic analgesia an incision was made over the left costovertebral angle and a large perirenal abscess encountered, from which 1000 c.c. of foul (colon) pus were drained. A nephrostomy was then done and 6 oz. of foul (colon) pus were evacuated

from the left kidney pelvis. A 3/8 inch rubber tube was sutured in the nephrostomy wound, the kidney pelvis washed with saline and then 2 ounces of 2 per cent mercurochrome injected and allowed to run out. He has made a satisfactory recovery and when his condition permits, I will operate and remove the calculus from the left ureter and allow the nephrostomy to heal. This case is cited to show how a chronic case can mask symptoms of most profound gravity.

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[For Discussion see p. 251.]

IDEAL OPERATION FOR UNDESCENDED TESTICLE

AND THE NECESSITY FOR THE OPERATION

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THERE is a legend very prevalent in the South that an undescended testicle should not be operated on until after puberty, as it is thought the testicle will most probably descend to its normal position in the scrotum at or just after puberty. This legend is not confined to the laity but is often recited by the members of our profession. Two years ago, I read a paper in Washington before the members of the Southern Railway Surgeons Association, entitled, "Are We Properly Disseminating Medical Knowledge to the Profession as a Whole?" When we consider what little foundation such a legend has in fact and what perfect opportunity there has always been for accurate observation and refutation, it is profoundly depressing that this legend should continue to exist among medical men. Bevan[1] says in regard to this legend:

> I fell into this error and stated on a number of occasions that inasmuch as the organs may descend in the period from birth to puberty that it was wise to defer operation until shortly before the age of puberty. I desire to state quite positively now that I think this position is erroneous, that there is little likelihood, if the organs are not in their normal position at birth, of their descending in the period from birth to puberty, and that I have never seen, in the large experience, a definite example of this kind. There is, however, a not infrequent condition which makes it appear as though such a descent did take place and this condition I have studied very carefully and desire to report upon.
>
> These are cases where there is a very rudimentary empty scrotum containing no testicles, but on careful examination one can feel the small testicles just beneath the skin above the scrotum, and with gentle pressure the testicles in these cases can be pushed down into the scrotum by running

the fingers from above downward in the groin, and brought down so that they can be seen and felt definitely in the scrotum. When the fingers are withdrawn, the testicles slip up out of the little empty scrotum and apparently you have the condition of undescended testicle, when as a matter of fact that condition does not exist at all, because as these children grow up these testicles develop normally in the enlarging scrotal pouch and give the parents and the physician the impression that they are cases of undescended testicles which have come down in the period of puberty.

Wangensteen[24] says:

Scrotal fixation of the undescended testis in its physiological position before the histologic changes incident to puberty occur will enable it to develop normally. It has also been shown that while the adult undescended testis is practically always aspermatic it does elaborate the mature germinal cells, and, if given a fair chance, the organ may become useful not only from an endocrine but from a procreative standpoint.

Hugh Cabot says[2]:

The work of Moore of Chicago is of more than passing interest in this connection. During the past ten years this investigator has done a tremendous amount of research work on animals of all types, and has definitely established the fact that elevation of temperature is the essential factor in retarded testicular development in cryptorchidism. Some of his experiments will bear citing. On progressively shortening the scrota of sheep and goats until the testes eventually lay flush against the body, progressive degenerative changes in the testes were noted so far as spermatogenesis was concerned. Likewise, experimental cryptorchidism, of both the abdominal and inguinal types, brought about these changes. He further established his thesis by ingeniously insulating the scrotum against loss of heat by radiation, and here again produced the same changes. On returning the testes to their normal scrotal position in the operative cases, and on deinsulating the others, he was able further to observe a return to normal spermatogenesis. Confirmatory evidence was also obtained by direct application of heat to the laboratory animals' genitalia for varying periods of time.

These experiments of Moore are certainly convincing of the necessity to place the undescended testicle in the scrotal sac before puberty, if we expect to have a normally functioning testicle.

Another, and a very important, reason for the early performance of orchiopexy is to cure the real or potential hernia that always accompanies an undescended testicle.

In his article read before the American Surgical Association in 1929, Bevan[1] says:

> Year after year we have been operating upon these cases earlier and earlier, and I am coming to the position that any time after the first year or two after birth, whenever this deformity is discovered and is definitely demonstrated to exist, and the child is in good general condition, an operation should be performed; and it can be done at that early age to better advantage than at a later period. It is true that the structures are very small and the tissues very delicate and that in operating upon these young children it is necessary to use especially small, delicate artery and tissue forceps and instruments, also very fine catgut; everything in keeping with the very small and very delicate structures. There are, however, definite advantages in doing the operation at this early age:
>
> First: The structures are more pliable and yielding.
>
> Second: The cord is more easily lengthened so that the organ can be brought down without tension.
>
> Third: There is less danger of doing enough injury to cut off the blood supply.
>
> Fourth: I believe there is a better chance for normal development.
>
> The results which we have obtained in these very early cases have been most satisfactory.

The danger of malignancy in the undescended testicle is no reason for an orchiopexy or orchidopexy, or a castration.

J. Dellinger Barney, in Lewis' "Practice of Surgery," says malignancy of the undescended testis seems to be more apt to occur than in the normal organ. Yet, as Wangensteen says, "no greater diversity of opinion probably exists concerning anything in medicine than the question of malignancy in the undescended testis."

The cause of the relative frequency of malignant disease in the undescended testis has been the subject of much study and debate. Perhaps the best explanation is offered by Ewing who bases his opinion on a study of several thousand serial sections of embryonic testes through the corpus Highmori and rete testis. He says:

Teratoma testis arises from sex cells in the neighborhood of the rete, whose normal development into spermatogonia has been suppressed, but whose potencies remain intact and later to express themselves in the various forms of simple or complex teratoma.

Previous to 1881 orchidopexy was done infrequently and with but poor success. In 1881 Schuller devised and in 1899 Bevan perfected an operation which with but few minor changes and modifications is used today. Dr. Bevan's operation as described by him in 1929 varies very little from the operation he described in 1899. In his first operation, he advised sacrificing the spermatic vessels in those cases where the cord could not be lengthened sufficiently to place the testicle in the bottom of the scrotum without tension by dissecting off the vaginal process of the peritoneum and dividing the network of fascial strands. He estimates that even in his early operations it was not necessary to sacrifice the spermatic vessels in more than 5 to 10 per cent of his cases. He now advises against division of the spermatic vessels because of the liability of atrophy of the testicle. Briefly, Bevan's operation is to make the skin incision as in inguinal hernia operations, expose the cord and testicle and then to begin a delicate and painstaking dissection of the vaginal process of the peritoneum from the blood vessels and the vas. He incises the vaginal process transversely about an inch below the internal ring, and, after dissecting it off up to and above the ring, ligates it, as in a hernia operation. The distal portion of the vaginal process is then dissected off, and he utilizes this for a tunica vaginalis for the testicle. If the cord is still not sufficiently lengthened, he minutely divides and tears the fibrous bands from the vaginal process and fascia, that wind around the vessels and the vas. The testicle is then placed without tension in the new scrotal bed that has been prepared for its reception. A purse-string suture is placed through the fascia at the scrotal neck without the least constriction of the vessels of the cord. The wound is closed without transplanting the cord.

The other operation for undescended testicle that is very popular is the operation devised by Dr. Franz Torek of New York. Up to the point of bringing the testicle through the scrotum, Dr. Torek's operation is identical to the operation described by Dr. Bevan. However, in addition to the meticulous lengthening of the vessels and the vas, as does Bevan, he brings the testicle out through an incision in the scrotum and attaches the testicle, after a skin incision, directly to the fascia of the thigh and covers it over by suturing the scrotal edges to the skin edges of the thigh. This is left undisturbed for about three months and it is then released and the testicle covered with its normal scrotal coverings. Dr. Torek claims 100 per cent perfect end results from his operation.

Personally, I have never done the Torek operation but I have seen the end results of this operation done by others and certainly I would not consider that all of the end results were ideal, but I can easily believe that it was because the operation did not closely follow Dr. Torek's admirable technique.

In my early operations for undescended testicle, I frequently ligated the spermatic vessels to lengthen the cord sufficiently to place the testicle in the scrotum without tension. Even today, if operating on an adult who had a normal testicle on the other side, I would not hesitate to ligate the spermatic vessels, if removal of the vaginal process of the peritoneum and the severing of the fascial bands did not give the necessary length to place the testicle in the bottom of the scrotum without tension. The knowledge that he has two testicles dangling in his scrotum, albeit one is somewhat shriveled, is a great pride and joy to the man who has had but one, and justifies in my opinion this not ideal technique. The Torek operation might obviate the necessity of cutting the spermatic vessels but many patients I am sure would prefer the liability of an atrophied testicle in the scrotum to a two-stage Torek operation. Possibly, I am influenced by the fact that I have not had a marked atrophy and no necrotic testicle when I have ligated the spermatic vessels. The ideal operation for

me has been the Bevan procedure with some slight modification. The ideal time is before puberty, from six to twelve years of age. The ideal technique is attained when you have a well-trained, interested assistant, adequate time, mosquito forceps, small-tooth forceps and a very keen, small knife. The goal is to free the vessels and the vas so completely that they are no longer covered or surrounded with peritoneum, peritoneal bands or fascial bands, without injury. I have found in doing hernia operations under local anesthesia that when the novocaine solution is injected around the cord it makes the dissection of the vaginal process much easier with far less trauma to blood vessels. I utilize this principle in my dissection around the vessels and vas in my operations for undescended testicles. After the cord has been lengthened enough to remain in the bottom of the scrotum easily, a twenty-day number 2 chromic catgut ligature is passed on a straight needle through the gubernaculum testis and tied lightly. The two ends are then passed through the bottom of the scrotum ½ inch apart and tied to a rubber band, and the band fastened with a little tension to a frame, or to the skin after the technique of Hugh Cabot. To me, this has been a most satisfactory and ideal operation.

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[For Discussion see p. 251.]

ENDOCRINE INFLUENCE IN THE PRODUCTION OF PROSTATIC HYPERTROPHY

AND A METHOD FOR ITS CONTROL*

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THAT certain glands secrete substances which have far reaching effects upon the body economy has been appreciated since the time of Claude Bernard. Since his work and that of Brown-Séquard an enormous literature has accumulated, dealing with the effects of hyperfunction and of hypofunction of each of the endocrine glands. In spite of an accumulating knowledge regarding the interaction of the hormones produced by the endocrine organs we are still too prone to treat only the gland which is obviously malfunctioning without seeking to discover whether or not the cause of that malfunction may be some disorder in another related gland. Thus it has recently been shown by Crile that in cases of residual or recurrent hyperthyroidism or even in some cases of primary hyperthyroidism the function of the adrenals may be attacked and the disease ameliorated or cured; and as the result of parathyroidectomy for various diseases, Leriche has demonstrated a direct relationship between the parathyroids, calcium equilibrium and nutrition of the skin and subcutaneous tissue, connective tissue growth and involuntary articular sensibility. So in dealing with diseases of the sexual organs it may be that some distant gland is in part at least responsible for the condition.

Although our central theme is the influence of certain hormones upon the prostate gland it will be of interest and value to offer a brief review of our present knowledge regarding the influence of the endocrine glands upon the sex organs.

* From the Cleveland Clinic.

Thyroid. Clinically it is known that patients with hyperthyroidism may have menstrual disturbances and diminished libido, and hypothyroidism also may result in sexual depression. Some cases have been reported in which thyroidectomy has led to atrophy of the sex organs but this action may be due to the retardation of the general metabolism which in itself would result in sexual depression. Hammet reports that in rats thyroidectomy produces diminution or variation in the weight of the testes or ovaries and an accelerated growth of the hypophysis in the male.

Various reporters have investigated the effects of castration on the weight of the thyroid gland but their findings are not in agreement. Thus Hatai finds that the thyroid is not affected by castration while others report some resultant hypertrophy.

Thymus. The mass of evidence points against any important relationship between the thymus and the sex glands, the best evidence of such a relation being its involution at puberty and its delayed involution following castration. Anderson, however, concludes that thymectomy does not prevent, hasten or delay sex maturity and does not prevent the occurrence of normal litters.

Various investigators have reported that the thymus is heavier in castrated than in normal animals and Soli (1909) reported that thymic involution is delayed in spayed females.

Reports on the effects of feeding thymus to young animals have been made by various investigators. Hewer reports delayed development and even degeneration of the testes and Guternatsch (1912) noted marked growth and delayed metamorphosis in tadpoles. However, doubt was thrown on all earlier experiments on the effects of thymus feeding by Romeis (1926) who found no resultant changes if an adequate supplementary diet was given.

A few reports state that the administration of thymic extract leads to delayed development of the testes, and that testis implants or the injection of adult serum hastens atrophy of the thymus.

Adrenals. Hirsutism, pseudohermaphroditism, sexual precocity, or masculinization is often associated with a tumor of the adrenal cortex, these phenomena disappearing in many cases when the tumor is removed. Most of the reported cases of adrenal tumors have been in females.

I have had one case that is interesting in this connection.

The patient was a girl, four years of age, who showed extremely precocious sexual development. Her breasts were well developed, pubic hair was present and she had menstruated. Examination appeared to show that the right kidney was abnormally large and therefore an exploratory operation was performed. The kidney was found to be normal but the adrenal gland seemed to be enlarged. It was decided to compare this with the left adrenal which was found to be even larger than the right one. The left adrenal and a portion of the right one were removed.

This child is now twelve years of age and a recent letter from her mother gives a picture of a healthy normal girl weighing 93 pounds, a normal weight, although when she was five years of age she weighed 75 pounds, as much as her sister who was ten years old.

She has always menstruated five or six times a year, but now she menstruates regularly every twenty-eight days. She enjoys all normal activities of a child of her age.

This brief outline is offered merely to illustrate the influence of the adrenals on the sexual organs and the possibilities of correcting the precocious development by the reduction of adrenal activity.

It is generally recognized that clinically hypofunction of the adrenals is often associated with decreased sexual function.

Various investigators have found that degenerative testicular changes occur in adrenalectomized animals. In pregnancy the adrenals are somewhat enlarged and the same is the case in ovulating birds. It has been observed that pregnant animals withstand the effects of adrenalectomy longer than normal animals as is true also of hibernating animals. This may indicate the role of the pituitary in this condition, although Rogoff and Stewart, and Mulon suggest that the corpus luteum acts as a temporary adrenal body.

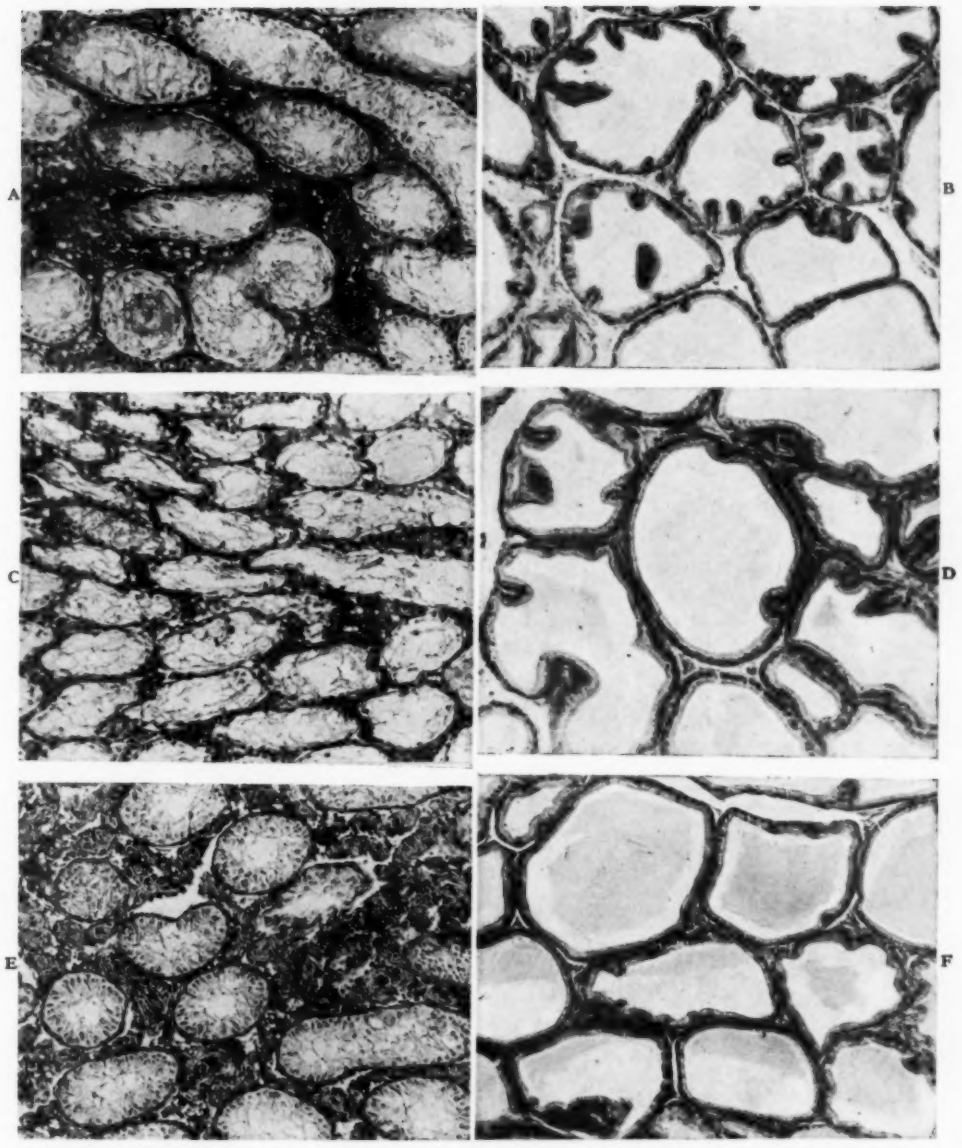

FIG. 1. Controlled doses of roentgen rays and emanation from radium seeds, or experimental cryptorchidism will produce degeneration of the tubular elements and a slight increase in the amount of interstitial cells. A, section of testes of a rat subjected to roentgen rays with (B) prostate of same animal. C, testis of rat subjected to emanation of radium seeds and (D) prostate of same animal. E, cryptorchid testis (experimentally produced) of a rat with (F) prostate of same animal. Note definite hyperplasia of prostatic epithelium in all three animals. (× 150)

That enlargement of the adrenals follows castration has been reported by some investigators, while feeding adrenals to animals leads to an increased size of the testes. Corey and

FIG. 2. Injection of male sex hormone into castrated rats can either prevent atrophy of prostate (A) or can regenerate an atrophic gland (B). (× 150)

Britton report that sex precocity, especially in female rats, is produced by injections of cortical extract. Klein found that injection of extract of the adrenal cortex produced an increased

size of the male sex organs and a decrease in the female organs.

Clinical evidence indicates a definite relationship between

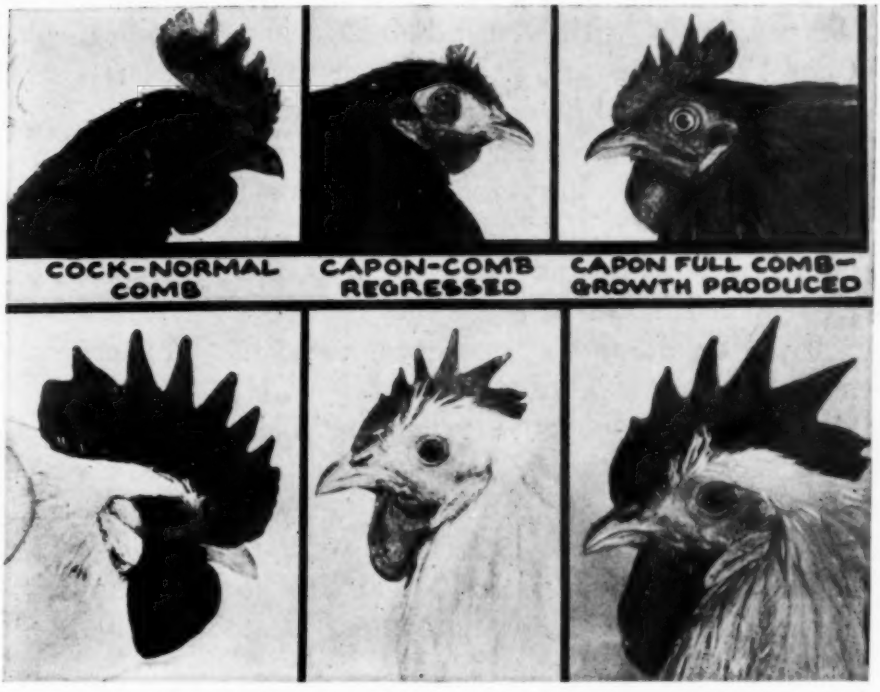

FIG. 3. Response of a capon's comb to injections of male sex hormone: showing complete regeneration of a capon's comb.

the adrenals and the sex organs. The experimental evidence as to such a relationship is not so clear but with the use of potent cortical extracts such as have been prepared by Swingle and Pfiffner, Hartman and others, there is gradually accumulating evidence which indicates a definite gonad-adrenal relationship.

Pineal Gland. Clinically sexual precocity is often associated with tumors of the pineal gland. Because of the reports of various observers and the fact that the pineal body begins to atrophy at about the age of puberty, a sex inhibiting function has been ascribed to this gland. There is, however, insufficient experimental evidence of a pineal-gonadal relationship. Extirpation experiments have been rather unsuccessful although

Foa, Horrax and others report that they found increased sexual activity and growth in various animals, mostly male, after removal of the pineal body; but other investigators report negative results.

Experiments with the administration of pineal gland extract have been unfruitful. Beach and Hulles report the occurrence of pineal atrophy in castrated cats.

Pituitary Gland. There is an abundance of literature relating to the pituitary-gonadal relationship. Sex precocity occurs in children with pituitary tumors while hypopituitarism results in infantilism and cases of hypoplastic genitalia have been reported in which acromegaly has been associated with menstrual disorders or impotence, these disturbances disappearing after removal of the tumor.

The pituitary-gonadal relationship is gradually being established by the work of many investigators. The enlargement of the pituitary gland in pregnancy and after castration has received attention and the effects of hypophysectomy have been studied by different investigators who have shown that the genital atrophy following hypophysectomy may be prevented by fresh pituitary implants. Smith and Engle have shown that pituitary hormone acts on the testes and these in turn on the secondary and accessory sex characteristics, a finding which as we shall show later has a direct bearing upon our own investigations. The work of various other investigators might be cited to show that there is a definite gonadal-pituitary relationship.

Epididymis and Prostate. A few reports state that extracts of the epididymis and of sperm contain material which promotes comb growth. Lawless found that in castrated rats with an intact epididymis the characteristic changes of castration occur. He concludes that in the absence of the testes the epididymis does not produce enough secretion to maintain the normal sex characteristics.

It has been claimed that the prostate gland has an internal secretory function. Serrallach and Paré found that the acces-

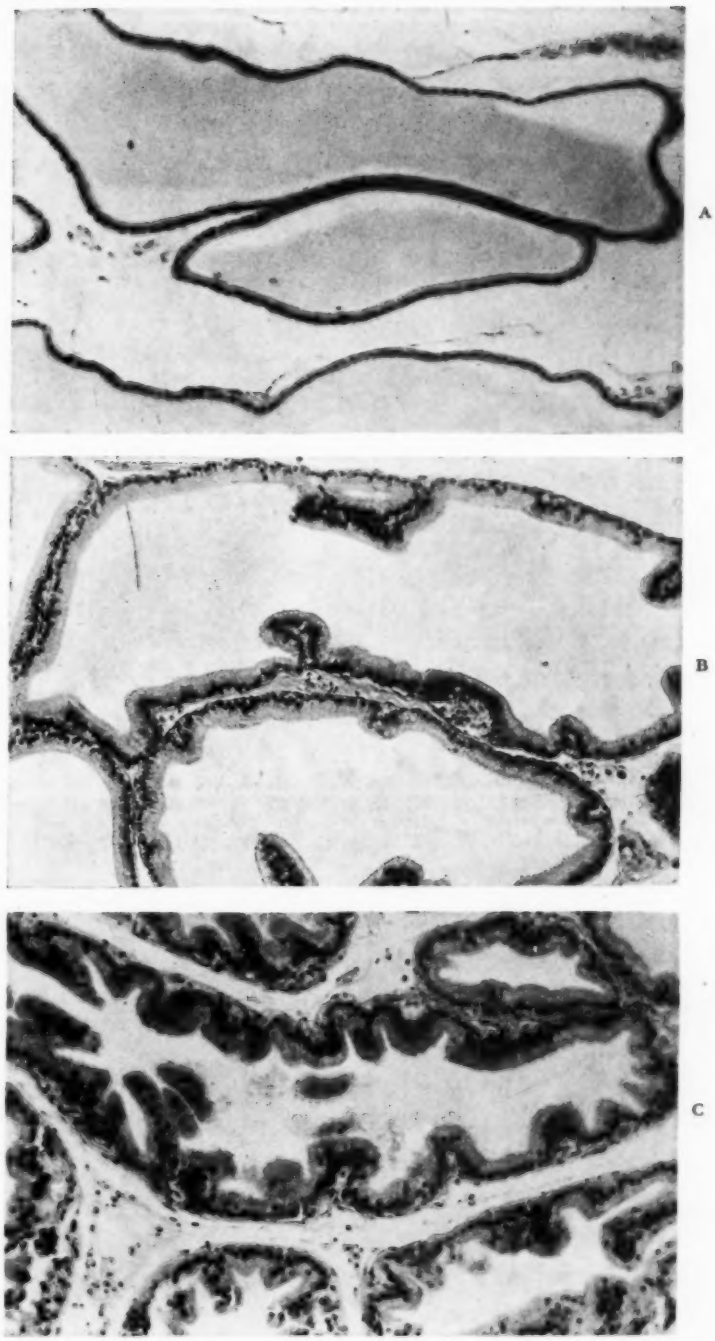

FIG. 4. Prostate gland of one of two normal rats in parabiotic union. There is no apparent change in epithelium from that of a single, untreated male. B, prostate of normal rat of a normal + castrated union. Excess of pre-hypophyseal hormone secreted by the hyperfunctioning hypophysis of castrate causes hyperplasia in normal partner. C, prostate of untreated partner of two normal males in parabiotic union; treated partner received daily injections of gonad stimulating hormone "Antuitrin-s." Note marked hyperplasia as compared to (A). (× 150)

sory sex organs atrophied following prostatectomy and that the atrophy was overcome by the administration of prostate extract. DuBois and Boulet found that the administration of normal prostate extract produced contraction of the bladder while extract of hypertrophied prostates did not produce such contraction. Collip and others have reported that the injection of prostate extract produces blood pressure changes. However, there is but slight evidence that the prostate has any important function as an organ of internal secretion.

Gonads. Some cases of precocious puberty have been observed in the presence of tumors of the testis or ovary. In some of these cases the symptoms regressed after the tumor was removed.

That atrophy of the prostate follows castration has long been appreciated. Experimentally it has been found that cryptorchidism, radiation, partial resection or transplantation of the testes leads to testicular germinal atrophy while the Leydig cells persist.

Because of these findings and the more direct evidence from experiments on urodeles in which Aron found he could remove the interstitial tissue which was gathered in a mass at the hilus, Bouin concludes that the interstitial tissue is the source of the secretion of the testis. Bascom has shown that the interstitial cells of the testes appear earlier than those of the ovary.

That there is a definite relationship between the testes and the secondary sexual characteristics and accessory organs cannot be doubted.

The sex influence of heterogeneous implants has been studied by Moore and others who found that when the ovary and testis are grafted together there is not antagonism between the two but rather a competition for the gonad-stimulating hormone. Lillie's experiments with the free-martin, a modified female, may be explained on this basis. This is essentially a parabiosis *in vivo*.

The effects of castration on the secondary sex glands may be completely nullified by the administration of the extract of male urine or of lipoid extracts of bulls' testes as has been shown by Moore and his co-workers.

That there is a definite male as well as a female hormone seems to be well proved.

Male Sex Hormone. Brown-Séquard was really the first to postulate that the testes have an internal secretion. Pezard, who was the first to study the effects of active extracts of the testes by the cock's comb method, found that extract from cryptorchid testes produced full comb growth in a capon. Since Pezard, various investigators have studied the male sex hormone problem extensively. These investigators found that it was present in the testes at all ages and in the urine though the amount is decreased in old age. They found further that this hormone will repair the changes produced by castration.

The work of many investigators has been summarized by Moore who concludes that there is an antagonism between the sex hormone and the hypophyseal gonad-stimulating hormone, an excess of either the male or the female sex hormones depressing the production of the hypophyseal hormone. Malnutrition also produces a depression of the hypophyseal function. This explains the effect upon the characteristic changes after castration of the administration of the heterogeneous sex hormone. Moore claims that the hypophyseal sex relationship exists by virtue of the presence of a hormone which acts directly on the gonads causing them in turn to act on the other organs of the generative system.

EXPERIMENTAL STUDIES

This is but a brief and general review of an enormous literature. It is sufficient, however, to indicate why in our studies of prostatic hypertrophy with special relation to prophylaxis we turned our attention to the endocrine relationship between the prostate and the other glands of internal secretion especially the testes and the hypophysis. Our

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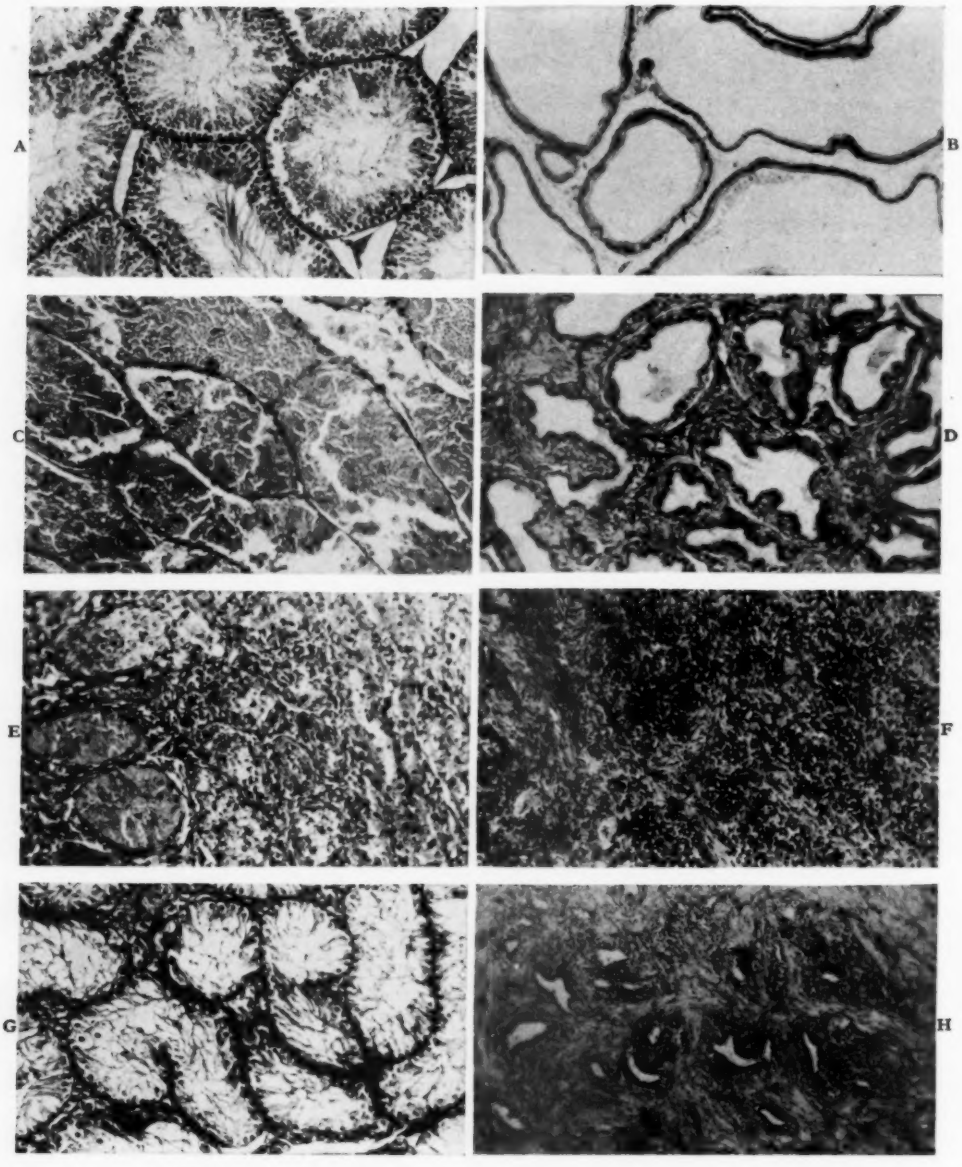

FIG. 5. In rat, bilateral vasotomy apparently has no effect upon testis, and consequently, none upon prostate (A and B). On other hand, ischemia of testis, whether produced by bilateral ligation of vessels of spermatic cord (C and D), unilateral section of these vessels (E and F), or bilateral section of spermatic cord (G and H) is followed by degeneration of testes and castration effects in prostate gland. Sections of testes shown in upper row; sections of prostates in lower row. (× 150)

premise was that if the testes produce a hormone which promotes the growth and activity of the other sex organs and if there are factors which will decrease the stimulation of the testes by the pituitary, some practical application might be made of these principles.

The following researches have been made with the collaboration of Dr. R. L. Johnston, Dr. D. R. McCullagh, Dr. N. F. Hicken, W. Kenneth Cuyler and recently Dr. E. L. Walsh has joined us. This work was done under the George W. Belcher Genito-urinary Research Fellowship, a gift of Roger C. Hyatt, Esquire.

Deaver states:[1]

> We are tempted to dismiss the subject of etiology of benign prostatic enlargement as did that most experienced of all modern prostatectomists, Mr. Freyer of London, by confessing our complete ignorance of the cause of the condition.
>
> It is undoubtedly true that but little has been added to our knowledge of the etiology of prostatic hypertrophy within the past fifty years; certainly the true cause or causes of the adenomatous form of the disease have not been demonstrated. . . .
>
> The whole subject of the relations of the testicle to the prostate is quite obscure and many very contradictory and apparently irreconcilable facts are at hand.

CHANGES IN THE FUNCTION OF THE PROSTATE GLAND AS A RESULT OF INJECTIONS OF PREHYPOPHYSEAL HORMONE

A group of immature male rats received daily injections of anterior pituitary hormone (Luteinizing hormone, Parke-Davis). All these animals exhibited a precocious sexual development with a definite hyperplasia of the prostate. When the same hormone was injected into adult male rats a larger dose of the hormone was required to produce hyperplasia, but when

[1] DEAVER, J. B., and HERMAN, J. L. Enlargement of the Prostate. Ed. 2, Phila., Blakiston, 1922, Chap. IV. Etiology and Predetermining Factors of Benign Prostatic Hypertrophy, p. 72.

excessive doses were administered, the testes and prostate were diminished. This indicates that the prehypophyseal hormone can stimulate either an immature or mature gonad and produce prostatic enlargement.

A number of adult male rats were castrated and were observed until the prostate and seminal vesicles were very small and atrophic. These animals then received injections of the anterior pituitary hormone over a long period of time. On autopsy the prostate and seminal vesicles were found to be still atrophic, and there was no evidence of cellular stimulation on microscopic examination. Three groups of castrated rats received respectively injections of a saline extract of rat's testes and anterior pituitary hormone, of an anterior pituitary hormone extract of rat's testes and of testicular mush (rat) and anterior pituitary hormone without any resultant stimulating effect. This tends to show that the anterior pituitary hormone cannot influence the size of the prostate in the absence of normally functioning testes.

If the hypophysis controls the development of the sex organs through the intermediation of the testes, does it influence the interstitial or tubular portions of the gonads to elaborate the so-called sex hormone?

In previous experiments it was shown that if the testes of rats were subjected to sufficient doses of *x*-ray or radium emanation there was a pronounced degeneration of the tubular and spermatogenic tissue with preservation of the interstitial cells. Radiation was applied to cryptorchid animals with the same results. Such animals were given prehypophyseal hormone for several weeks at the end of which the same degree of prostatic enlargement was seen as in the group of normal males that received similar injections. It appears that anterior pituitary hormone stimulates the interstitial cells of the testes to produce the "sex hormone" that governs the size of the prostate, and that the tubular and spermatogenic tissue plays no part in its production.

STUDIES OF INJECTION OF THE "MALE SEX HORMONE" AND ITS INFLUENCE ON THE TESTES AND PROSTATE

The excess of the "male sex hormone" that is formed by the anterior pituitary gland and the gonads is excreted in the urine, as demonstrated by Funk and others. In the Department of Biochemistry, of the Cleveland Clinic Foundation, Dr. D. R. McCullagh has developed a method for extracting this substance from the urine. The extract is then purified and can be injected into animals without toxic reactions.

We were interested to know whether this hormone as it is found in the urine is the same as that which produces enlargement of the prostate. Normal adult male rats and mice were given daily injections of the purified extract secured from urine. There resulted a definite hyperplasia of the seminal vesicles and prostate. Another group of rats were castrated and after the secondary sex organs became atrophic, the animals received injections of the "sex hormone." It was found that both the prostate and seminal vesicles had returned to normal size, and if large injections were continued the epithelial tissue resembled that of a hypertrophied prostate. Thus in the absence of the gonads and their secretion, the "hormone" found in urine was able to regenerate the atrophic sex organs, and even produce a hyperplasia.

If the secretion found in normal urine is the same as that formed by the testes, then one should be able to prevent the atrophy of the sex organs that follows castration. The rats were castrated and then received daily injections of the sex hormone. One month later the animals were examined and the prostate and seminal vesicles were found to be normal, no atrophy having taken place. Apparently the replacement action of the male hormone had been to supply the substance that the gonads generate so that normal prostatic growth was maintained.

From these studies of the hypophyseal-gonad relationship, we may conclude that the anterior pituitary gland activates

the interstitial cells of the gonads, which elaborates a hormone that governs the size and function of the prostate and seminal vesicles. The "male sex hormone" found in the urine of normal males, when injected into either normal or castrated animals, is capable of producing prostatic enlargement.

AN EXPERIMENTAL RESEARCH BY MEANS OF PARABIOSIS OF THE HYPOPHYSEAL-GONAD INFLUENCE ON THE GROWTH OF THE PROSTATE GLAND

We have already described experimental studies in which it was demonstrated that the injection of anterior pituitary lobe extract into a normal male rat acts through the intermediation of the gonads and produces prostatic hypertrophy. But in administering this hormone, one does not know whether he is injecting one or several substances. How then could a pure, untreated pituitary hormone be obtained? It was known that the hypophysis of castrated animals increased in size and presumably in function. How then could the pituitary secretion be transferred from the castrated to the normal animals without chemical extraction? This was accomplished by producing an anatomical union between two animals, by so-called parabiosis.

A lateral skin incision was made on opposite sides of each animal from the hip to the shoulder, and each abdominal cavity was opened by a lateral incision extending from the pelvic girdle to the diaphragm, the muscular walls and peritoneum of the two animals being sutured in a circular fashion, so that a permanent artificial opening connected the two peritoneal cavities. The skin was then closed in a circular manner, the technique being similar to that used in a gastroenterostomy. This artificial opening permits a free exchange of peritoneal fluid, and the intestines of one animal may pass into the peritoneal cavity of its partner. In 45 such mates the anastomotic opening has remained patent in all but one case, and the average diameter of the stoma, measured at time of autopsy, was 2.5 cm.

The transference of secretions from one animal to its partner could occur by means of a collateral vascular circulation at the site of anastomosis, or by serous absorption of the substance from the peritoneal secretions. Three cubic centimeters of methylene blue were injected into the jugular vein of the castrated male, but the dye could not be detected in the opposite animal. This precludes the possibility of vascular anastomosis. Three cubic centimeters of a 50 per cent solution of glucose were injected into the femoral vein of one animal, and in two minutes a pronounced hyperglycemia was produced in its mate. Glucose is highly diffusible and had passed from the blood stream of the injected rat into its peritoneal fluid and was absorbed by the peritoneum of the opposite animal. This demonstrates that there is a physiological transmission of substance between the parabiotic mates.

These pseudo-Siamese twins live together in perfect harmony without any disturbance in their normal function. If two adult female rats are joined together, both animals have regular estrogenic cycles. If two female rats are twinned just after impregnation, they have a normal period of gestation, and give birth to healthy, normal-sized litters. If this parabiotic union disturbed the functions of the reproductive organs one might expect the pregnant subjects to abort, but such was not our experience.

Seven pairs of normal male rats were joined together, and the animals were sacrificed at varying intervals from one to eight weeks after their junction. There was no change in size, weight or microscopical appearance of the pituitary gland, prostate or seminal vesicles when compared to a single control.

Castrated male rats were twinned with normal males. The prostate and seminal vesicles of the castrate became small and atrophic, and the pituitary increased in size. In the normal partner the testes, prostate and seminal vesicles were hypertrophied, but the pituitary gland remained normal. If the rats were permitted to live for thirty days, the prostate was

increased both in size and weight from 300 to 500 per cent. The gland was firm and solid and had a preponderance of glandular tissue; however, the prostatic enlargement was uniform. It required ten days for any changes to become evident but from then on the hyperplasia was very rapid.

What physiological change can account for this enlargement of the prostate in the normal male? After obliteration of the gonads in the castrated male, the hypophysis is increased in size and function. The excessive prehypophyseal hormone passed from the castrated animal over into its normal partner and caused the testes to secrete an excess of the sex hormone which resulted in hypertrophy of the prostate. That the hypophysis of a castrated male is hyperfunctioning can be demonstrated by twinning a castrate with a normal female. The pituitary secretion passed into the female, stimulated the ovaries and produced a protracted estrous cycle and enormous hyperplasia of the horns of the uterus and the vagina. Similar results were obtained by injecting anterior pituitary extract directly into a normal female.

There are two apparent explanations as to why the hypophysis of a castrated animal becomes hyperfunctioning. (1) When the gonads are present they utilize the pituitary secretion, but when absent the unused hormone accumulates in the blood stream; or (2) the testes may exert an inhibitory influence on the pituitary gland and in the absence of this limiting factor, the pituitary becomes overactive. The functional activity of the pituitary gland can be determined by transplanting the gland to a normal animal, and by such a technique, Martins demonstrated that the pituitary of a castrated animal is hyperfunctioning and concludes that the testes exert an inhibitory influence on the rate of pituitary activity.

Thus, by merely altering the endocrine system, so as to cause hyperfunction of the pituitary gland and permit the hormone to pass into a normal rat we have obtained a prostatic enlargement. No drugs, chemicals or medicaments have been

injected. This shows that hypertrophy of the prostate is a physiological reaction, and that the enlargement seen in elderly men may be but an expression of a functional disturbance of the endocrine system. Any condition which stimulates the pituitary gland and the gonads to elaborate an excessive amount of the male sex hormone may result in physiological prostatic hypertrophy.

If this theory is correct, patients having enlargement of the prostate should have a greater concentration of sex hormone in their blood stream and urine than normal individuals. After considerable work, we have developed accurate methods for assaying the amount of sex hormone found in the urine, blood and spinal fluid. The average concentration of the hormone for various age groups and in different diseases has been determined in a series of patients suffering from prostatic enlargement. There was an appreciably greater concentration of sex hormone in the blood and more excretion by the kidneys than in normal patients.

From a consideration of these results, it would seem that prostatic enlargement is a physiological mechanical effect due to hyperactivity of the hypophysis and the interstitial cells of the testes.

DUAL ENDOCRINE FUNCTION OF THE TESTES

It is a well-recognized fact that the ovaries secrete several hormones and it seems reasonable that its male analogue, the testes, should elaborate more than one secretion. "Androtin," the so-called male sex hormone found in urine, is made by the interstitial cells of the gonads and is comparable physiologically and chemically to theelin, which is formed by the ovaries. Dr. D. R. McCullagh in our Department of Biochemistry, has been interested in the secondary functions of the gonads and has made the following observations.

In our previous experiments we demonstrated that castration produces atrophy of the seminal vesicles and prostate, and an increase in the size of the pituitary and adrenal glands.

If the male sex hormone is administered to a castrated rat the atrophic seminal vesicles and prostate will regenerate and even become hyperplastic, but the pituitary and adrenals remain in their recently acquired hyperplastic state. This indicates that the fat-soluble hormone found in urine can prevent atrophy of the secondary sex organs, but does not contain the hormone which apparently regulates the function of the pituitary gland. After the injection of aqueous extracts of rat testes into castrated males, the prostate and seminal vesicles became atrophic, but the pituitary did not become hyperfunctional (Martins and Rocha). Evidently this aqueous extract supplied a substance which inhibited the hyperfunction of the pituitary gland but did not contain the hormone required for development of the prostate.

The interstitial cells of the testes secrete a fat-soluble hormone which regulates the male generative organs and experimental evidence indicates that the germinal epithelium inhibits the hyperfunction of the pituitary gland. Thus it appears that the testicle is secreting two hormones. An intensive study of these two hormones is now in progress.

If our contention that the germinal epithelium of the testes secretes a substance which inhibits overactivity of the pituitary gland be true, then it has a definite clinical application. In men senescence produces degenerative changes in the germinal epithelium and a retardation of spermatogenesis, both of which indicate diminished functional activity of these cells, as a result of which there would be a smaller amount of pituitary inhibitory secretion and the hypophysis in turn would increase in size and become hyperfunctional, and would stimulate the interstitial cells of the gonads, to elaborate the excess of the male sex hormone, resulting in prostatic hypertrophy.

These experiments indicate two ways by which hypertrophy of the secondary sex organs may be prevented: First, by inhibiting the influence of the anterior lobe of the hypophysis, and second, by inhibiting the influence of the gonads. From a clinical point of view, the first is at present rather

difficult of accomplishment unless a satisfactory and safe inhibiting hormone can be found. I am hopeful this may be done. As to the second procedure, much can be accomplished by this means and we have considerable clinical evidence in this direction.

Clinical evidence of the effect of controlling the testicular secretions is illustrated by the findings in the examination of a group of eunuchs who were castrated for various pathological conditions. Dr. E. Perry McCullagh, of the Cleveland Clinic, made a very complete study of these eunuchs which included basal metabolism tests, check of the male hormone, etc. In no instance could any male sex hormone be demonstrated and in every case the prostate was small and atrophic. In a case of extensive epithelioma of the penis, I removed the external genitalia, the penis and gonads, and transplanted the urethra into the perineum. I also removed the inguinal glands. At the time of the operation this patient had quite a large prostate and difficulty in urination. More than three years have passed since the operation and not only has there been no recurrence of this growth but his prostate has become small and atrophic and the urinary symptoms have disappeared.

The effect of castration has been known for a long time and in the early nineties was practiced rather extensively, Dr. J. W. White, of Philadelphia, being the principal advocate of this procedure, but his mortality rate was high and the procedure was never received with much enthusiasm although numerous cases have been reported.

In 1897, the late Sir Robert Jones of Liverpool reported an interesting case:

> A man sixty-seven years of age was suffering from almost complete urinary obstruction. The bladder was distended to above the umbilicus, the urine was alkaline, fetid, loaded with mucus and contained pus and the prostate, which was as "large as a Newtown pippin," presented a marked convex protrusion in the rectum, was hard and unyielding and painful to the touch. The scrotum was covered by herpes. For four months every effort was made to cure the herpes and to keep the bladder clean and empty

but without any improvement except in the herpetic condition. Both testes were then removed and the patient made an uneventful recovery. Two weeks after the operation the prostate had sensibly diminished in hardness, there was less pain and the urine was less fetid and purulent. Six weeks later the patient was able to dispense with the catheter. A year later the prostate was reduced in size "by a good half." The patient could retain his urine for four hours, there was hardly any residual urine and the bladder contractility was assured. The patient himself said "I'm a young man, free from pain, strong and active."

Jones reports 3 other cases on the basis of whose results he states: "My experience, therefore, of castration in enlarged prostate, judged in the light and promise of 4 cases, is distinctly a happy one, and should, I venture to think, encourage us in more frequent recourse to it."

Having demonstrated both experimentally and clinically the effect of putting the interstitial cells of the testicles out of commission, we have tried methods other than castration for accomplishing the same results. We have shown experimentally that the results of castration can be obtained by ischemia, that is, by depriving the testicle of its main blood supply. We decided to try this clinically. The main artery to the testicle is the internal spermatic, a branch of the aorta, which is given off just below the renal vessels. The other arteries supplying the testicle are the external spermatic, a branch of the inferior epigastric, and the deferential which follows the vas closely.

In a limited number of clinical cases we have tried this procedure and a marked diminution in the size of the prostate has been noticed. The series, however, is too small to draw any conclusions.

I firmly believe that in the rather large, soft glands we may expect very definite reduction in the size of the gland by reducing the blood supply to the testes and thereby controlling the endocrine influence.

In doing herniorrhaphies for direct inguinal hernias, I have repeatedly divided the entire cord and atrophy of the testicle on that side followed in course of time but in no instance was there sloughing. I decided to try this procedure clinically in

cases of prostatic enlargement. In a limited number of cases, I have divided the entire cord. In two instances sloughing followed and I had to remove one testicle in one case and both in another. Since then I have divided only the internal spermatic and deferential arteries together with the vas. No sloughing has followed.

DISCUSSION ON PAPERS OF DRS. LIVERMORE, NEWELL AND LOWER

DR. GUY L. HUNNER, Baltimore, Md. I understood Dr. Livermore to say that most of us cannot follow the conception that ureteral stricture is the only cause of stone. I think that ureteral stricture, with its constant urinary stasis, is perhaps the most important cause, and I think it will be only another twenty years before most urologists will recognize this fact and then will find that their treatment of stones will be revolutionized.

I will refer to the last four patients I have been interested in. Two of the patients are still in the hospital. The first is a woman, aged twenty-nine, who had a stricture on the opposite side with some slight dilatation. The ureter was dilated down to a point in the pelvis. All her symptoms were those of bilateral stricture. I treated her as a stricture case and did not get a flat film and roentgenograms which showed a small renal calculus until the fourth dilatation. In the first three examinations I never got above a narrow area at the pelvi-ureteral junction. In the fourth I got a scratch on the wax bulb. The next week the patient had chills and fever but had no infection in the kidney at any time. She came back about ten days later and a picture then showed the stone in the lowest part of the ureter. By cystoscopy we could see the stone sticking out of the ureter and it was easily removed by forceps.

The second was a patient with a navy-bean-sized stone, located beside the midsacrum. When we saw this patient we had a visiting Englishman in the hospital who was very much interested in this subject. I told him we could probably demonstrate stricture on the opposite side although the patient had never had pain on the left. We found an 18 c.c. pelvis. Those who hold with Braasch that we should not consider these dilated until they hold 30 c.c. will not agree that this is a dilatation, but I think it is. Just before leaving for this meeting I passed bougies up to size 16 F. and hope to have the stone passed. (This stone passed two days later.)

The third patient was a woman six or seven months pregnant who had a little stone blocking the left ureter. It had been blocked for forty-eight hours. I attempted to push the stone back up into the kidney and let her

go on to term. The bulb showed stricture in the lower ureter, and the tip obstructed in an area opposite the third lumbar spine and immediately below the stone. We were forced to operate immediately. As evidences that the patient has stricture on the right side her history shows that she passed two stones from the right side at the age of fourteen, and eleven days after our emergency operation on the left side she developed a right pyelitis.

Dr. T. B. Reeves, Greenville, S. C.: Soon after I graduated I became interested in the endocrine influence on the testicle, and while working with Dr. Whitehead, in the University of Virginia, his attention was called to a horse that had been castrated and afterward had all the characteristics of a stallion. Dr. Whitehead was asked to see this horse and, as I recall, he took out another testicle which he found to be made up primarily of interstitial cells. He got me interested in the subject, and said that if the interstitial cells had anything to do with the production of heat in animals we should find a lot of interstitial cells in the roosters. We examined several roosters and found quite a number of cells. We carried the work along until spring and examined different varieties of birds. Again we examined them in the fall and in the spring, always the same type of bird, and found an increase in the cells. We feel that the interstitial cells do have something to do with the production of heat in animals.

That work was done ten or fifteen years ago and I wish to know whether Dr. Lower feels that interstitial cells have anything to do with the production of heat in animals.

Dr. William F. Shallenberger, Atlanta, Ga.: I wish to mention a piece of work that has recently been done to determine the sex of the unborn child by means of the injection of urine from the pregnant woman into the ear veins of immature male rabbits. The rabbits are about three weeks old and sexually immature, and about 10 c.c. of urine from the pregnant woman are injected. If the unborn child is a male there is no change in the testicles of the rabbit. If the unborn child is a female, however, there is very definite stimulation in the development of the testicles of the rabbit. This, offhand, would seem rather paradoxical and one would expect that it might work the other way. Just what hormone is responsible for this is not yet known but it is well known that in the pregnant woman large quantities of anterior pituitary hormones are excreted in the urine and the Aschheim-Zondek test for pregnancy is based on this. I do not know whether any observation has been made with reference to stimulation of prostatic development. This work has been carried out in a rather limited way thus far, but in about 57 cases in which it has been tried it has been positive in determination of the sex in 53, and in the 4 failures it was figured that failure was due to not selecting rabbits of proper age.

In reference to Dr. Newell's paper I wish to mention that it has been shown that in undescended testicles spermatogenesis is considerably retarded. It has been suggested that the testicle in its normal position is not subjected to full body heat whereas the undescended testicle is. It has also been shown that certain Japanese bath attendants who remain in hot water hour after hour and day after day are notoriously sterile and this is probably due to the long, continued heat to which the testicles are subjected.

Dr. George R. Livermore (*Closing*): No man deserves more credit than Dr. Hunner for his work on stricture of the ureter. He stood alone for years in his belief that stricture was a definite pathological entity, and he deserves credit for proving to us that he was right and we were wrong. The fact that stasis is one of the causes of stone in the ureter, the kidney and the bladder is too well known at this time to need comment. You have all seen cases of hydronephrosis in which stone was found in the kidney or ureter.

Dr. E. Dunbar Newell (*Closing*): In bringing up this subject my idea was to find the best time to operate on these cases and the best method of operating. I did not get as good results several years ago as I do now. Most of my cases then were adults. It is much more difficult to get the testicle into the scrotum at that time than it is when operation is done early. If we remember that this is a very time-consuming, painstaking operation, and if we take the time to remove peritoneum and the fascial bands, it is remarkable how we can lengthen the cord and place the testicle in the bottom of the scrotum. Most authors speak of freeing the cord, but this is not sufficient. We must free the vas and all the fibrous bands that draw these together. If we do this before puberty we will be able to place the testicle in the bottom of the scrotum without tension. I think the reason so many men are not getting the results they wish is because they are not taking sufficient time to dissect out all these tissues.

CYSTECTOMY FOR CARCINOMA OF THE BLADDER

REPORT OF CASES

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PORTLAND, ORE.

IT will be conceded that the principal deterrent from radical surgery of the bladder up to within recent years has been the lack of a satisfactory substitute for the bladder as a reservoir for urine. The rectum is the only satisfactory substitute because it is accessible and has an adequate sphincter under the control of the nervous system. For more than half a century doctors have sought by experimentation to devise a plan whereby the ureters could be implanted into the rectum in such a way that the kidneys would not be destroyed as a consequence. Such a plan is now at our disposal. When found, it was seen to be nothing more nor less than nature's universal plan for duct delivery into a muscular reservoir. It is based upon a single fundamental principle which may be stated as follows: A duct intended to deliver the secretory output of an organ in which the pressure must be low and regular into a muscular reservoir in which the pressure is high and irregular, must lie in the interlamellar space immediately beneath the mucosa of the receiving organ before it enters the lumen or chamber of the receptacle.

As means of surgically applying this principle in the transplantation of the ureter, three definite methods of procedure or plans of technique have been introduced and designated Techniques 1, 2 and 3, in respect to their chronological order of development.

Technique 1. The ureter is drawn into the interlamellar space immediately outside the intestinal mucosa and its split end is dragged through an opening made in the mucosa at the

caudal end of the intestinal incision and anchored inside the intestine, thereby bringing the open ureter into the intestinal lumen at the time of operation.[1]

Technique 2. A tube or catheter is fastened within the ureter by ligatures which both seal the ureter against intestinal infection and anchor it to the catheter, after which the catheter is passed through an opening made in the mucosa at the caudal end of the intestinal incision and is used to draw the ureter into the interlamellar space immediately outside the intestinal mucosa and through the opening in the mucosa into the intestinal lumen. The urine is transmitted from the upper ureter through the catheter into a receptacle outside the body. The open ureter is exposed to intra-intestinal pressure only after the intra-intestinal end of the ureter sloughs and permits the catheter to come away eight to sixteen days after operation.[2,3]

Technique 3. The ureter is brought into the interlamellar space immediately outside the intestinal mucosa by an anchor stitch which fastens the end of the ureter in the angle of the caudal end of an uncompleted intestinal incision. The anastomosis is gradually made by a tightly tied suture which transfixes both the ureter and intestinal mucosa. The anastomosis is complete two to four days after operation.[3–6] (Fig. 1.)

Technique 1 requires two separate abdominal operations for transplantation of the ureters. It has been successful in several hundred operations for exstrophy of the bladder performed by many operators. However, it is not suited for carcinoma of the bladder or prostate, even as a palliative measure, for the reason that the first operation is so serious and convalescence is so prolonged and eventful that one scarcely feels justified in submitting the patient to a repetition of such an ordeal when it is known that relief will be but temporary at best. In earlier cases suited for cystectomy, the patient who has undergone two major abdominal operations with two sieges of prolonged convalescence following ureteral transplantation is not a good subject, either physically or mentally, for cystectomy performed as a third major operation. The

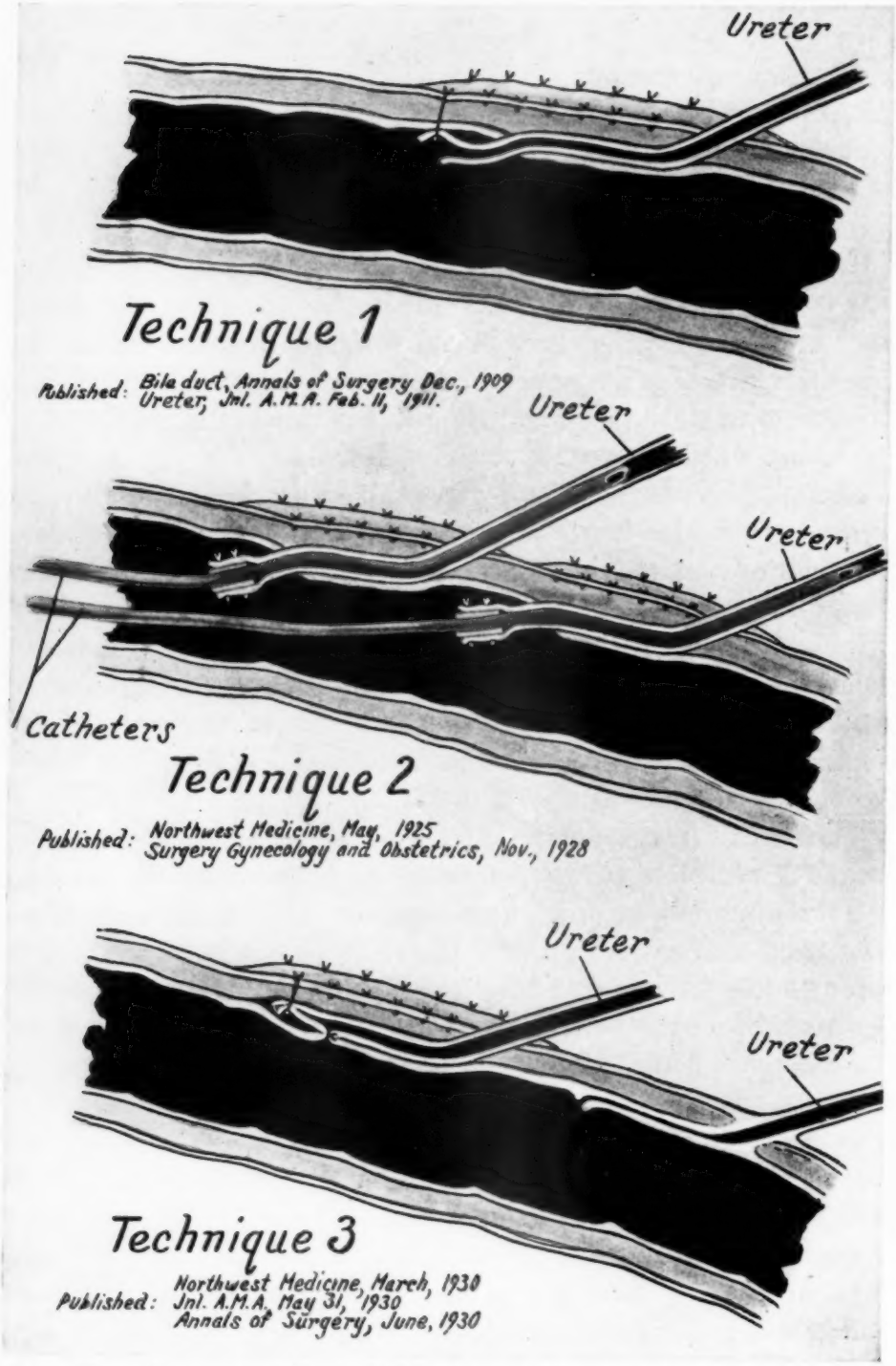

FIG. 1. Three plans or principles of technique for transplantation of ureters by submucous implantation method.

growth, moreover, has been extending during these several months of convalescence and the chances of permanent cure are materially reduced thereby. It has been found also that most cases of carcinoma of the base of the bladder requiring cystectomy have at least one dilated ureter with a damaged kidney.

Technique 2 was devised to overcome these obstacles.

At first, the double transplantation operation, technique 2, was done only in hopeless cases as a palliative measure. In some of the less advanced cases in which the growth was still confined to the pelvic cavity, a large dosage of radium was applied but with only slight success. In some of these cases, in addition to radium, destruction by cautery was used without conspicuous success.

In a paper read at the meeting of the Southern Surgical Association at Atlanta, Georgia, in December, 1929, along with a report on the use of radium and cautery in advanced cancer of the bladder in connection with ureteral transplantation, an incomplete report was made on 2 cases of cystectomy for cancer of the bladder in women performed two and three months after the ureters had been transplanted. I am now able to make a report on 11 cases to date, including postoperative progress and late results. Most of the cases have been reported previously in abstract or incomplete form.[3,5,7] This paper reports in detail the contingencies that have arisen as well as the present condition of the patients with the hope that it may be of some help to those who desire to embark in this field of surgery.

CASE 1. A woman, aged fifty-four, married, with carcinoma of the bladder, registered at our clinic May 1, 1927. Examination revealed a papillomatous growth in the bladder; it was fulgurated unsatisfactorily. The trigone afterward bled easily on being touched and presented a definitely malignant appearance. On May 26, 1927, a cystotomy was performed; 50 mg. of screened radium were placed directly in contact with the growth. It was held in place by a gauze pack for twenty-four hours. The growth disappeared. By June 22, 1928, the growth had returned and transplantation was advised. The operation was performed on July 3, 1928,

number 12* catheters being used. The patient returned from the surgery in good condition. On the first postoperative day there was occasional vomiting but both catheters were draining well. Albumin water was taken on the second day, and on the third the patient expelled gas freely. On the fifth day the patient took a liquid diet, and the bowels moved. On the ninth day there was pain over the left kidney, and on the tenth, both catheters were draining but some urine escaped into the rectum. The catheters were removed on the twelfth day, and on the twenty-fourth the patient walked on the porch. On the twenty-fifth postoperative day the patient complained of feeling chilly, and there was a rise in temperature. On the twenty-eighth, the patient was fully dressed. On the thirty-second day, 2400 mg. hours of radium were applied in the vagina. The patient was discharged on the thirty-fourth postoperative day.

September 20, she was re-admitted for a cystectomy. The wound was drained through the vagina. On the ninth postoperative day the patient had a chill; the temperature was high. The chill and fever resulted from a mammary abscess following subpectoral infusion. The patient was very anemic and much depleted following the sepsis from the sloughing. She was presented at the clinics held during the meeting of the American Medical Association, July 9 and 11, 1929 at which time she reported that she was feeling well, holding the urine without distress for two or three hours during the day. She stated that she got up once, sometimes twice, at night. She also stated that she was doing the housework and cooking for a family of ten.

This patient has reported for observation several times since, the last time being July 1, 1932 when she was shown at a clinic given in Portland for the western branch of the American Urological Society. At this time she was in still better health, had recovered from her anemia, was able to hold the urine all night and was entirely comfortable, four years after operation.

CASE II. A woman, aged fifty-six, unmarried, an American teaching in Saloniki, Greece, developed carcinoma of the bladder. The diagnosis was made by Dr. Karl Gagstatter of Vienna who recommended ureteral transplantation. The patient came to me on August 19, 1929. The bilateral transplantation operation was done August 22, 1929. The growth, which proved to be more extensive than was suspected, was an infiltrating carcinoma. It involved the base and neck of the bladder. The condition was apparently suitable for destructive radium treatment. The ureters were somewhat dilated and slightly thickened. Number 12 catheters were used. After the right catheter was fastened in the ureter, it was discovered that the catheter did not extend over the psoas muscle as far as usual but no

* The numbers indicating the size of the ureteral catheters referred to in this paper are those of the Charrière scale.

fear was entertained as to results. The left catheter began to drain immediately. The right catheter was dry. At 3 P.M. the right catheter was irrigated with boric acid solution. A few drops returned, probably only the injected solution. The patient complained of pain in the right kidney region. At 8 P.M. a stylet was passed but no urine was returned. After this, boric acid solution was injected but did not return. During the night the patient complained of general pain in the back, being more marked in the right kidney region. Twenty-three hours after operation the patient was taken to the operating room. Under local anesthesia, through a loin incision, the fatty capsule of the kidney was opened, the ureter identified by passing the finger along the muscle wall, and brought backward with a small flat hook retractor. The ureter was somewhat dilated and seemed congested; it was slit with a sharp knife, and a few drops of turbid urine escaped. A small soft rubber catheter was introduced about 2 inches into the pelvis of the kidney. Four small gauze wicks were placed around the catheter to hold it in place and two sheets of rubber tissue around this to provide drainage. The operation required only a few minutes, and there was no shock. The catheter began to drain a few drops of turbid urine, but within two hours clear urine was coming from the kidney. On the fifth postoperative day, methylene blue was introduced through the distal right ureteral catheter and immediately came through the loin dressings. Several ounces of water were then run through this ureter. The loin catheter and gauze wicks were removed and on the second day afterward the rubber tissue was removed and the wound was allowed to heal by granulation. This procedure is much simpler and much less dangerous than to attempt to deal with an obstructed catheter through the rectum.

The patient had 4600 mg. hours of radium in the bladder fourteen days after the transplantation, and enough later applied from the vaginal side to make nearly 6000 mg. hours.

On November 26, 1929, cystectomy was performed. A transverse incision not completely severing the recti was made one inch above the symphysis pubis. With the finger ends, the bladder was separated from the pelvic wall. The peritoneum was separated from it without opening the free peritoneal cavity. With a nurse's gloved finger inside the vagina as a guide, the neck of the bladder was mobilized with the index finger, the anterior vaginal wall was opened, two clamps were placed on the urethra and the urethra severed between them. It was a very simple matter, then, to remove the anterior wall of the vagina and bladder intact. The bladder cavity had contracted down to a very small space and the bladder wall had become thickened. There was still an unhealed ulcer about one inch in transverse and one-half inch in anteroposterior diameter. The pathologist made numerous sections of the bladder wall, including the ulcerated area.

Notwithstanding the advanced carcinomatous growth that was present at the time the radium was applied, he was unable to discover any typical cancerous growth due, no doubt, to the destructive action of the large dosage of radium. The space from which the bladder had been removed as well as the remaining vagina was packed sufficiently tight to control the hemorrhage, which was not severe. The end of the gauze pack was then brought out through the vagina. Three days later, the long gauze pack was removed through the vaginal orifice. A drain was then inserted into the vagina.

This patient made a tedious recovery, due to infection in the abdominal wall and mons veneris which was probably augmented by the large dosage of radium. The pubic bones were left entirely denuded of periosteum. The cartilage at the symphysis came away but the bones finally healed with a fibrous union after three or four months. On May 6, 1931 she reported herself in unusually good health. At that time she was working for the Associated Charities and had to walk several miles a day.

On September 29, she was present at a meeting of the western division of the American Urological Society. She stated that she was in splendid health and that her weight was 170 pounds. On July 2, 1932, she again appeared before the same society at its Portland meeting in perfect health. She stated that she was able to perform her very strenuous duties in connection with the Associated Charities in complete comfort. She was seen again on December 10, 1932.

The Atlanta paper of 1929 dealing with cystectomy closed with the following statement:

The ideal for which we yet hope is the early diagnosis of cancer, when it is still confined to the wall, in which the skilled surgeon will be able to transplant the ureters and do the cystectomy at the same operation, leaving a quarantine at the lower end of the abdomen to drain the vesical space as well as the transplantation area.

On March 12, 1930, an opportunity to realize this hope came to me. Dr. W. D. Haggard referred a relative of his, who lived near Portland, to me for operation for cancer of the bladder. This case was reported[5] as follows:

Case III. C. E. R., male, poultry farmer, aged fifty-nine. He gave a history of blood in his urine off and on for about three years. On December 12, 1929, he began to have severe pain in the right kidney region. This persisted until the latter part of January, when he began passing clots of blood. This bleeding continued. A diagnosis of cancer of the right side of the bladder had been made by a competent urologist.

The patient entered our clinic March 12, 1930, and the diagnosis of cancer was confirmed. As he was having a great deal of bleeding and a great deal of pain, operation was advised and he was told that he would probably have his bladder removed and the ureters transplanted into the rectum. He went home to arrange his affairs. During these few days at home he had an alarming hemorrhage from the bladder. A doctor was called to give him relief. At the time he first consulted us, he had a hemoglobin of 96 per cent; the blood pressure was 170/100; urine showed blood and pus but otherwise was normal.

He returned and entered the hospital March 20, 1930, with hemoglobin of 66 per cent. A blood transfusion was given and on the twenty second his hemoglobin was 78 per cent. He was operated upon March 22. The ureters were transplanted into the large intestine by Technique 2, and the bladder was removed by the technique described in full in the previous report.[5] Briefly stated, the plan of operation was as follows: A catheter was inserted and the bladder was filled with 95 per cent alcohol following a suggestion of Dr. Edwin Beer.[8] The alcohol was retained in the bladder by clamping the catheter. When the abdomen was opened, the right kidney was found to be hydronephrotic and the right ureter dilated. After the ureters had been transplanted by Technique 2, the posterior peritoneal incisions were closed, thus covering the implantation wounds with peritoneum. The entire pelvis and lower abdomen were filled with sterile gauze to avoid any possible soiling of the abdominal cavity during the cystectomy. At this time the alcohol in the bladder was allowed to escape through the catheter. The peritoneum was detached from the fundus of the bladder with scissors, and from the lateral pelvic wall with the finger as far as the iliac vessels. The anterior trunk of the internal iliac arteries were temporarily closed with light clamps. With an assistant's finger in the patient's rectum as a guide, the fingers of the operator's left hand proceeded with the freeing of the bladder, seminal vesicles and prostate from the rectum and from the pubic bones (Fig. 2). After ligating the vasa deferentia and clamping the two lateral ligaments of the bladder, the urethra was clamped (Fig. 3), and bladder removed. A pack of gauze* was firmly drawn into the bed of the prostate by pulling on an attached catheter in the urethra.

When the excised organs were examined, an infiltrating cancer of the wall of the bladder 1½ inches in diameter, involving the right ureteral opening was found (Figs. 4 and 5). The right ureter was dilated to the size of the index finger (Fig. 6). The pelvis of the right kidney was correspondingly dilated and hydronephrotic. The left ureter was thickened but only

* A gauze strip, 12 inches wide and 10 feet long, is folded to four thicknesses, edges inside. This makes a ten-foot tape which when packed into a cavity or space is referred to in this article as a "gauze pack."

slightly dilated. The left kidney appeared to be normal. While the patient was not greatly shocked, the hemoglobin was low and it was decided to give him another blood transfusion at the close of the operation. He left

FIG. 2. Mobilization of bladder by fingers has just been completed, including vesiculae seminales and prostate. Catheter, which has been used both to drain bladder and inject it with alcohol, is still in place. An assistant's finger is in rectum as a guide.[5-8]

the operating room with a pulse of 76, full and of good quality.

Progress: The temperature the day before the operation was 102°F. and remained so until two days after the operation. After this during convalescence it ranged from normal in the morning to 99°F. and 100°F. in the afternoon. Four days it went as high as 101°F. in the afternoon and the pulse was

over 100 on five separate days during the convalescence. At no time did the patient present the appearance of being seriously ill.

The total output of the left kidney during the first thirteen days was

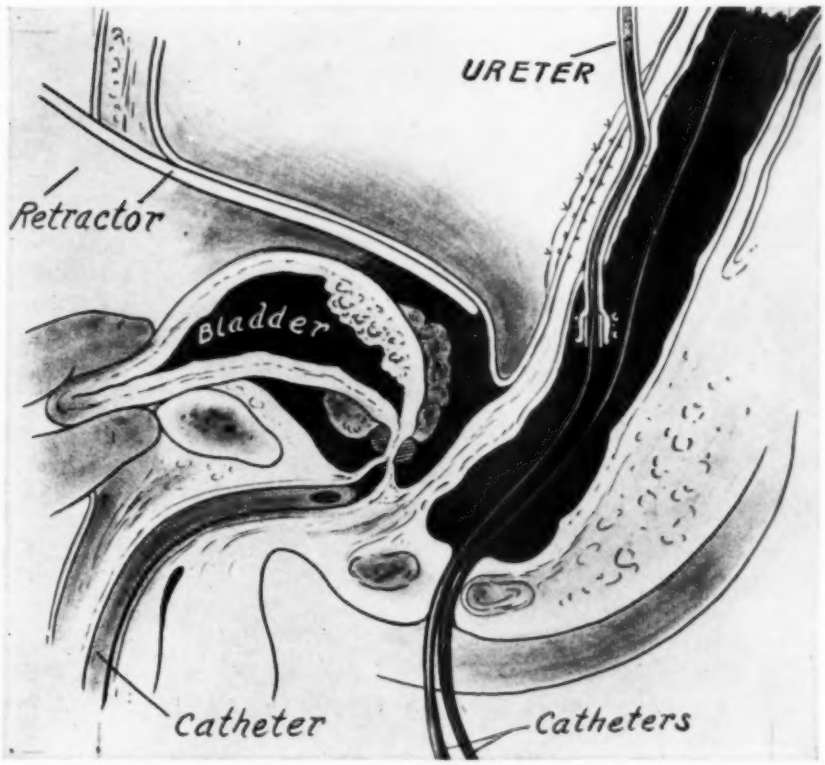

FIG. 3. Catheter has been slipped outward while an angle forceps clamps prostatic urethra. In a moment urethra will be cut just below clamp, and bladder removed intact with its neck closed.[5-8]

16,985 c.c., while that from the hydronephrotic right kidney with the dilated ureter was 3467. When phenolsulphonphthalein was given intravenously, the dye appeared from the left kidney in six minutes and from the right in twenty minutes. This delay in appearance from the right kidney, however, may have been due to the greater capacity of the pelvis, thus requiring longer time for the dye to reach the end of the catheter as well as to the lessened secretion. The function in this dilated kidney is in accordance with our former observation in cases where the ureter has been enormously dilated at the time of operation. In all such cases, the kidney is correspondingly damaged and apparently never recovers entirely. During the thirteen days that the catheter remained in, so that comparison could be noted, there was no change in the relative output of the two kidneys.

At the end of eight days, the gauze pack was removed from the bladder space which was lightly repacked with sterile gauze. A week later the packing was again removed without anesthetic. The wound was held open with

FIG. 4. Bladder specimen laid open through posterior wall, showing growth involving right ureteral opening. Case III.[5–8]

a bivalve retractor or speculum and inspected inside with the aid of Cameron lights after which the cavity was repacked. This was done again in six days, at which time the wound was washed out very carefully and a beautiful granulating cavity was exposed and inspected. This space gradually closed by granulation. There was never at any time the slightest pain or discomfort in the region of either kidney. The patient's appetite was fairly good. It may be said he made an uneventful recovery.

On October 1, 1930, this patient reported that he was entirely well and fully able to carry on his poultry farming. He asserted that he hadn't the slightest distress from the urine in the rectum. On several occasions since that time he has very graciously reported to the clinic for the benefit of

surgeons who were particularly interested in this work. His last visit was in November, 1932 when he was entirely well, comfortable and was able to do all the work required on his farm. His blood urea and renal function

FIG. 5. Microscopic section of growth. Case III.[8]

(phenolsulphonphthalein) were taken and found to be normal.

CASE IV. M. R., woman, aged forty-five, teacher, unmarried. Referred by Dr. G. E. Chittenden, urologist of the Akron Clinic, Akron, Ohio, who included the following history in his letter:

"About two years ago while at Edinburgh, Scotland, she was taken with what was apparently an attack of pyelitis. In November, 1928, she was under the care of a urologist in the Cleveland Clinic. Since that time she has had fulgurations of the recurring bladder papillomata in the Akron Clinic and in the Jackson Clinic of Madison, Wisconsin. She has been under my care since February, 1930. At that time she was having frequency, urgency, nycturia and microscopic hematuria.

"At cystoscopic examination, I found a very acutely inflamed bladder with considerable edema of the mucous membrane but could not get any detailed information. She had bladder irrigations for two weeks and another

FIG. 6. Right ureter enormously dilated as result of passing through growth.[8]

cystoscopy was done, at which time I found two small papillomata slightly anterior to the left ureteral orifice and one larger papilloma about the right ureteral orifice. These were fulgurated on February 28, under nitrous oxide anesthesia. Cystoscopy about the middle of March revealed a fairly normal bladder mucous membrane except for some injection of the blood vessels. At a pelvic examination about this time, I could feel no definite tumor mass in the bladder area but I did feel something which I thought was the ovary lying close to the bladder on the right side.

"In the past month she has had a return of hematuria, and cystoscopy about three weeks ago revealed a more proliferating process around the right ureteral orifice. One week ago I removed a piece of tissue from this area and the section revealed definitely epitheliomatous neoplasm. In the intervening three weeks between the two cystoscopies there was more extension around and behind the right ureter.

"I have advised operation and told her that because of the recurrence of the growth on both sides of the bladder walls, it would possibly be necessary to do a ureteral transplantation and cystectomy."

The patient registered at our Clinic June 23, 1930. Physical examination showed systolic blood pressure 122, diastolic 90, pulse 70, temperature normal, hemoglobin 80, occasional extrasystole with slight mitral regurgitation. The patient was rather feeble in appearance.

Cystoscopic examination was reported as follows: Bladder capacity small. There is a rather large growth occupying the posterior wall of the bladder just above the ureteral orifices. The growth is largest just above the right orifice, where it mounds up. It then seems to extend under the mucosa to the region above the left ureter, where it again crops out in a papillomatous mass with a broad base. Diagnosis: Cancer of the bladder.

On June 28 the operation was performed under ethylene anesthesia. Operative findings: The growth involved the entire thickness of the bladder over a large area and seemed to infiltrate the connective tissue around the bladder. The ureters were dilated, particularly the right which was also thickened, obviously from an infected kidney which was swollen at the time.

Operation: Through a long median incision, extending down to the symphysis pubis, bilateral transplantation of the ureters by Technique 2 was done. The transplantation was easy. After the wicks and gutta percha tissue had been placed in the slits of the peritoneum for retroperitoneal drainage, the bladder was removed, which required about twenty-five minutes. The growth infiltrated the connective tissue around the bladder which made dissection near the base of the bladder difficult. The vagina was opened during the process. The wound was packed with gauze. After operation, a transfusion of 600 c.c. of whole blood was given.

Progress: The patient was not seriously shocked from the operation and her condition was especially good after the transfusion. The right catheter began to drain soon after operation, the left one a little later. The urine from the right catheter was purulent and filled with mucous flakes. The right catheter became blocked about twelve hours after operation and it was impossible to keep it open. Water injected into the catheter did not return. This phenomenon is noted when the eye of the catheter is

filled with a clot. There was a slight discharge of foul-smelling liquid from the catheter.

Twenty-four hours after operation, the patient had a slight chill and forty hours after, another. After forty-eight hours, there being no drainage from the right kidney, under local anesthesia a loin incision was made through which the ureter was reached and opened. Considerable purulent fluid poured out. A catheter was inserted into the proximal ureter far enough to reach the pelvis of the kidney. Small wicks surrounded with rubber tissue were placed in the wound and in contact with the slit in the ureter. After a few hours the crippled right kidney began to discharge normal urine through the catheter and continued to do so.

Twenty-four hours after the operation, the patient developed marked arrhythmia and showed decided cardiac symptoms, but otherwise apparently was not very sick. There was no evidence of peritonitis or of increase in blood urea. The pulse was very irregular and, while it was not rapid on the fifth day, she suddenly became worse and died on July 5, the seventh postoperative day.

Postmortem by Dr. H. H. Foskett, pathologist, showed the following: Peritoneum is moist, smooth and glistening throughout with the exception of areas in contact with drains. A slight hematoma is evident at the site of the surgical wound. A portion of the omentum is attached in the pelvis and its surfaces covered with fibrinous exudate. These areas have apparently been in contact with the gauze drains which are packed in the pelvis. The lower pelvis is studded with areas of necrotic tissue. The stomach is moderately dilated. The gall bladder projects below the costal margin. On opening the chest, the lungs meet in the midline and appear to be normal. The space occupied by the pericardium is not increased in size. The heart is normal size. There is no evidence of any pathologic change in the pulmonary valve leaflets, nor in the leaflet of the tricuspid valve. The aortic valve leaflets are soft and pliable. The mitral valve leaflets reveal no gross pathologic changes. The left kidney is approximately normal in size. The ureter reveals evidence of congestion but is not dilated. The lining of the pelvis of the kidney reveals evidence of moderate hemorrhage. There is moderate cloudy swelling of the parenchyma. The right kidney reveals more marked congestion.

The post-mortem examination did not satisfactorily reveal the physical cause of death. The kidneys functioned perfectly to the last and there was no uremia. The direct cause of death probably was myocardial weakness, marked by an uncontrollable arrhythmia which began twenty-four hours after the operation. Possibly a better statement of the cause of death would be "Too much surgery on a frail patient."

CASE V. G. E. S., male, aged fifty-one. Patient was referred by Dr. H. E. Cleveland of Burlington, Washington.

He registered at our Clinic August 2, 1930, with the following history: In November, 1928, had a left nephrectomy by Dr. Cleveland for what had been diagnosed as stone in the kidney. No stone was found but the kidney was found to have a papilloma in the pelvis. The patient continued to have a great deal of distress in the left side. Papillomata began to appear in the bladder.

About the first of February, Drs. J. Tate Mason and Cleveland removed the ureter and excised a small portion of the bladder around the ureteral opening. Patient still continued to have distress and the papillomata increased rapidly until they appeared over the entire mucosa (Fig. 7). Despite frequent and vigorous fulguration, the papillomata persistently recurred and increased in number. The patient was in very great distress, lost some blood, and it was conceded that the bladder would certainly have to be dispensed with in some way.

After discussing all phases, it was thought best to have the ureter transplanted and the bladder removed.

The operation was performed on August 5. The right ureter was transplanted by Technique 2 and the bladder removed. The vesical space was packed with five yards of gauze tape which controlled the hemorrhage.

In this case an attempt was made to find the anterior trunk of the internal iliac artery as was done in Case III, but this artery must have been anomalous as it was not possible to find this trunk. The bladder was removed down to the neck, including the mucosa covering the prostate. Rubber tissue was placed outside the gauze to prevent it from attaching to the obturator nerve which runs along the lateral wall of the pelvis from above downward like a taut string.

Progress: During the first twenty-four hours after operation, the temperature ranged from 99° to 100°F., pulse 110. The catheters drained well. Second, third, fourth and fifth days were uneventful. On the sixth postoperative day, the patient was given a gas anesthetic and the gauze pack removed. He complained of pain low down on the right side and on the inside of the leg which is very characteristic of obturator nerve pain. On August 17, the twelfth postoperative day, the catheter came away.

Recovery of the patient was uneventful until August 20, the fifteenth postoperative day, when he had a slight chill and was somewhat nauseated. His temperature rose to 104°F. but rapidly receded, until on the following day it was normal. On the following evening, he had another slight chill with a temperature of 102°F. His temperature then for several days varied from normal up to 102°F. This slight rise of temperature, alternating with

normal, continued until the patient left for home on August 9, the thirty-fifth postoperative day. The wound had practically healed. He was having no distress from the urine in the rectum and felt well.

FIG. 7. Mucous membrane of open bladder studded with papillomata. Case v.[5-12]

Some time after he went home where he was under the care of Dr. Cleveland, he had a number of attacks of pyelitis and what appeared to be a partial intestinal obstruction. On one occasion his symptoms became so severe that Dr. Cleveland opened the ureter through the loin and passed a large sized catheter down through the ureter into the intestine. It was fastened into position and remained there for some time but finally was

allowed to come away. The loin incision healed and the patient made a good recovery. Dr. Cleveland reported this case at the meeting of the North Pacific Surgical Association at Spokane, December 3, 1932, at which time he showed a recent radiogram of the kidney made by intravenous pyelography. The kidney seemed to be in good condition, although the ureter and pelvis were slightly dilated. The patient is symptomatically well. Blood urea was normal.

CASE VI. J. D., male, aged forty-five. Referred by Dr. R. T. Boals of Salem, Oregon, who stated in his letter of reference: "I have made a cystoscopic examination of the patient's bladder and got a small piece of tissue of the same and had it examined by the Hollister-Steir Laboratory of Spokane. Patient has a bleeding ulcer on the left side at the base of the bladder, one-half inch below the mouth of the left ureter which bleeds quite freely. He has a toadstool-like growth about one-half inch to the left of the right ureter and on the base of the bladder. My diagnosis is papillary carcinoma of the bladder. Visualization of the kidneys by uroselectan shows both kidneys practically normal, also by the same means shows the left ureter all right for the last four inches."

The following history was obtained from the patient on August 18, 1930: First noticed bleeding from the bladder about four or five years ago. Did not last very long. Cleared up in a few days. About a year later upon doing heavy work again noticed some bleeding, but has always had a little discomfort in left side of back in kidney region. Last February had quite a severe hemorrhage with clots. The patient became very weak. Some loss of weight had occurred. He had had some medication. He was better for a month. Since that time on any exertion his urine had been bloody. About two weeks ago he passed a piece of tissue which was sent to a reliable laboratory and diagnosed as papillary carcinoma of the bladder which was confirmed microscopically by our own pathologist; also by Dr. Spangler of our Clinic who made the urologic diagnosis for us.

Operation was performed on August 21. To avoid dissemination of transplants of the growth in case of accidental opening of the bladder, it was filled with 95 per cent alcohol before the transplantation operation was begun. The catheter used to introduce the alcohol was then clamped and remained in the bladder during the entire operation.

Through the abdominal incision, bilateral transplantation of the ureters was performed according to Technique 2 except that the slits in the posterior parietal peritoneum were closed entirely, as drainage was later to be established through the space occupied by the bladder. When the transplantation of the ureters had been done, the pelvis was packed full of gauze to prevent soiling of the field in case of accidental rupture of the bladder. The alcohol was withdrawn at the beginning of the cystectomy operation

and when this operation had been completed the vesical space was packed with 5 yards of gauze tape. At the time of the packing, both obturator nerves were seen along the outer pelvic wall. Incidentally it may be stated

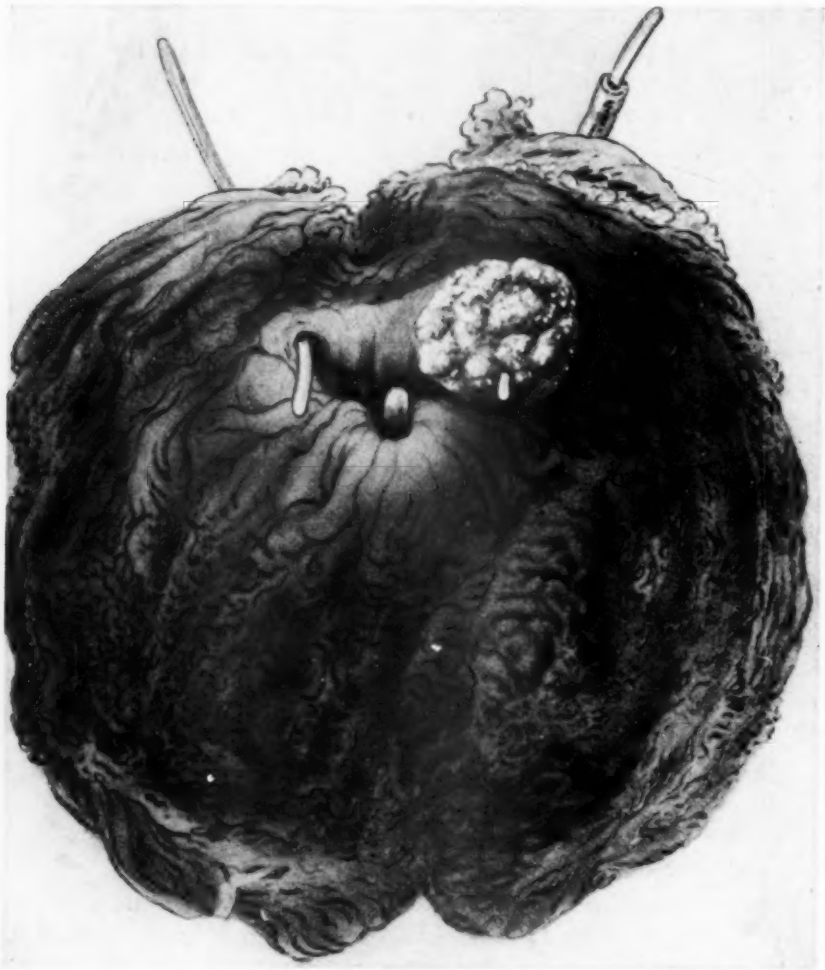

FIG. 8. Bladder open, showing carcinoma involving left ureteral opening. Case VI.[5-12]

that these nerves are very conspicuous and stand out fully ½ inch from the muscular wall. This sometimes accounts for a pain running down the inner side of the leg, brought about by too tight a packing of the pelvic cavity. The anterior trunks of the internal iliacs were not ligated and were not very much in evidence but all the larger blood vessels could be easily ligated by sight. While the loss of blood was not great, a transfusion of 600 c.c. of whole blood was given as an extra precaution. (Fig. 8.)

Progress: No shock followed the operation and convalescence was uneventful. The temperature once or twice went as high as 101°F. and only during the first two postoperative days was the pulse above 92. Both catheters drained from the beginning and throughout convalescence until August 31, the tenth postoperative day, when the right catheter came away and the urine discharged into the rectum and was carried off for a few days by a rectal tube. On September 6, the sixteenth postoperative day, the left catheter came away. The gauze pack was removed at the end of the first week under light gas anesthesia and after the wound had been thoroughly irrigated and cleansed, the wound was repacked with a five yard gauze tape. At the end of the second week, the gauze was again removed, a bivalve vaginal speculum inserted in the wound, the wound thoroughly irrigated by introducing the fluid with a flushing tube and withdrawing it through a suction tube. The cavity was carefully inspected and gauze inserted. This was repeated every five days until the thirtieth postoperative day, when the patient was permitted to be up on his feet.

Recovery continued uneventfully. The urine was held for two or three hours at a time and the patient was not uncomfortable. Occasionally the rectal sphincter for the first few days would allow a little leak of urine. This is true in nearly all cases until the sphincter becomes adjusted to holding fluid.

The patient continued to convalesce until perfect recovery. He very kindly presented himself for exhibition at the meeting of the western branch of the American Urological Association on July 2, 1932 at which time he reported to the members of the Society that he was entirely well and able to do his farm work with comfort and that he had no difficulty or inconvenience in holding his urine.

Case vii. M. V., female, aged sixty-two, married, mother of ten children. Referred with a diagnosis of carcinoma of the bladder. She had been given four deep roentgen-ray treatments, on August 26, 27, 29 and September 2, 1930.

The patient registered in our Clinic on September 6, and gave the following history: For many years has been troubled with burning and distress in the bladder with frequency of urination. For the past year has been passing blood off and on. This frequency has increased lately. During this year she has lost 30 pounds in weight. About three weeks ago she had quite a severe hemorrhage from the bladder.

At the time she entered the Clinic, she had a sallow complexion. She stated that the roentgen-ray treatment had made her very sick and that she had developed a slight jaundice. Our cystoscopic examination confirmed the diagnosis of advanced carcinoma of the bladder, involving the left side of the bladder wall and particularly above the ureters. A dose of

castor oil was given the patient for the purpose of preparing the bowel for ureteral transplantation. This made her very ill and she vomited severely for nearly twenty-four hours. After this she recuperated and began to feel quite well but complained of great distress in the bladder. On September 8, she was given a transfusion of 600 c.c. of whole blood.

On September 9, the operation was performed. After the abdomen had been opened and the rectum had been cleansed and packed with gauze in preparation for the transplantation of the ureters, a catheter was inserted and the bladder was filled with 95 per cent alcohol to remain until the transplantation operation was completed.

After the abdomen was opened, the kidneys were carefully palpated. The right kidney was slightly smaller than normal, somewhat lobulated, the pelvis somewhat dilated. The right ureter was but slightly dilated. Upon exposing the pelvis for ligating the ureters, it was observed that the left ureter was very large and deeply congested, particularly that part below the point of crossing of the psoas muscle. After the peritoneum had been slit and the left ureter lifted, it was found to be as large as a man's index finger, filled with urine, deeply congested and of a purplish color. It was clamped and ligated down in the connective tissue of the broad ligament. At a point near the lower clamp there was discovered a small hard gland about three times as large as a millet seed. This was removed and submitted for frozen section examination. The pathologist reported the growth as carcinoma, Grade IV, Broder's classification. Careful search was made for other glands along the ureter, both above and below the point of section, but none could be found. No metastatic nodules could be felt in the liver and there was no evidence of distant metastasis. The right ureter was larger and thicker than normal but not materially dilated.

The ureters were transplanted in accordance with Technique 2. Both catheters began to discharge urine immediately, while the patient was still on the operating table. The purplish, dilated condition of the left ureter was cause for a good deal of apprehension and the possibility of its later sloughing above the anastomosis could not be eliminated. Wicks were placed in the lower angle of the posterior peritoneal incision back of the uterus, from which the ureter had been lifted, and rubber tissue above the wicks.

At this stage of the operation the clamp was released from the catheter and the alcohol allowed to escape from the bladder. An infiltrating growth could be felt on the left side of the base of the bladder in front of the left ureter. The growth seemed to have invaded the connective tissue to a certain extent. The pelvis and the entire lower portion of the abdomen were temporarily packed with dry, sterile gauze to prevent possible soiling in case of accidental rupture of the bladder during operation. The vesico-uterine fold of peritoneum was slit transversely and the bladder was

gradually pulled forward by using gauze on a gloved right hand, while the left hand mobilized the bladder from the vagina and lateral pelvic wall.

The bladder was separated from the vagina as far down as could be

FIG. 9. Advanced carcinoma encroaching on left ureteral opening. Case VII. (Appearance of this growth is similar to growth observed in Case II before it was destroyed by radium.)[5–12]

done conveniently and the growth on the left side had been mobilized from the connective tissue on the left broad ligament. The vessels were isolated and clamped. After the fundus of the bladder had been well mobilized, the neck was identified by the catheter which still remained in the bladder. The urethra was thereby isolated and held between the left thumb and index finger of the operator. A nurse then withdrew the catheter, while the operator held the urethra and doubly clamped it. It was then severed and

the bladder was separated from the vaginal wall and its lateral attachments from the urethra backward. By working first above and then below, the bladder, to which was attached the ligated stumps of the ureters, was finally removed with relative ease (Fig. 9). No great amount of blood was lost. The patient, however, was already anemic and 600 c.c. of whole blood were given by direct transfusion. The vesical space between the uterus and pubic arch was packed with a 10 foot tape of gauze to control the slight oozing and to drain the space.

Progress: Both catheters began to drain. The patient vomited persistently after the operation, much the same as she had following the dose of castor oil. Fluid was supplied by subpectoral infusion. The vomitus was principally mucus and clear fluid. During the entire period of vomiting, she had an intermittent pulse. On the third postoperative day vomiting ceased and she began to take beef juice and albumin water. Her appetite was poor and she belched a good deal.

The day after operation, the left catheter gave a good deal of trouble. The eyes of the catheter were blocked by debris from the dilated ureter and kidney pelvis. In view of the condition of the ureter at the time of operation and the possible danger of its sloughing at a later stage, it was decided to expose the left ureter below the kidney and drain it. Under local anesthesia, in the line of the usual kidney incision, the kidney fat was exposed and opened and a finger passed along the posterior abdominal wall until the ureter containing the catheter was easily palpated. With a flat hook retractor, it was pulled slightly toward the wound. A longitudinal incision was made through its wall down to the catheter. No urine escaped. The ureter at this point was by no means so large as it was in the pelvis. Four small wicks were placed, two on each side of the ureter. This was surrounded by two pieces of rubber tissue, making a cigarette drain. The catheter began to drain freely while the patient was on the table and never became blocked again. As far as could be determined, no urine escaped from the incision in the ureter as long as the catheter remained in the rectum.

On the ninth postoperative day, the left catheter ceased to drain and a few hours later it came away. The urine poured into the rectum but none drained through the loin wound. On the eleventh postoperative day the right catheter came away.

The patient grew weaker and became more sallow. On the fourteenth postoperative day, she was decidedly jaundiced but the kidneys acted well until near death which occurred on September 24, 1930, the fifteenth postoperative day. Postmortem examination showed some chronic pyelitis and chronic nephritis but no serious acute involvement of the kidneys and no peritonitis. The cause of death was exhaustion. The jaundice indicated that the liver might have been at fault.

It was a mistake to have operated upon this patient at all under the circumstances and certainly the combined operation of ureteral transplantation and cystectomy was a regrettable error.

CASE VIII. A. P., male, aged forty-eight, bookkeeper. He had consulted a surgeon and a urologist both of whom had pronounced his case primary carcinoma of the prostate gland with extension into the seminal vesicles. Briefly he gave the following history: He had been entirely well up until four months ago when he noticed some blood in his urine which gradually increased in quantity. He had no discomfort.

The report of our urologist was as follows:

Prostate: Large 2. Very nodular and irregular. Very firm. Feels very suspicious of malignancy though I cannot differentiate between this and chronic prostatitis.

Seminal vesicles: Old dark bloody secretion. 12–15 W.B.C. There is not enough evidence to rule prostatitis in or out in the presence of blood.

Impression: Very suspicious of malignancy though it could be an inflammatory condition.

Feb. 10, 1931: Cystogram with sodium bromide shows a bladder of apparently normal contour. No irregularity or filling defects. Whole urethra except prostatic portion well visualized and normal. Prostatic portion contains no bromide solution.

Feb. 12, 1931: Intravenous pyelography shows rapid visualization of pelvis, ureters and bladder. Good filling in plate taken immediately after end of injection. Calyces are not well visualized.

Plates forty-five minutes later show about the same picture. No evidence of dilatation. Good function.

Impression: Normal appearing kidneys, ureters and bladder from roentgenological standpoint.

From my own personal examination, I fully concurred with the diagnosis of the previous urologist who had unhesitatingly pronounced the condition one of primary cancer of the prostate with extension into the seminal vesicles.

The operation was performed on February 14, 1931. After the usual preparation for ureteral transplantation, the bladder was filled with 95 per cent alcohol which remained in the bladder during the transplantation operation. After the transplantation was finished, the pelvis and lower abdomen were packed with gauze to prevent any possible soiling of the peritoneal cavity in case of rupture of the bladder. Separation of the bladder from the peritoneum was begun at the fundus and continued down to the base of the bladder where the involved and distended seminal vesicles were encountered. The separation of the bladder from above and behind proved to be very difficult if not impossible. So my activities were turned to the

neck of the bladder, and finally one finger was passed around the urethra (Fig. 10). The urethra was then cut and separation of the prostate and seminal vesicles from below upward proceeded without difficulty (Fig. 11).

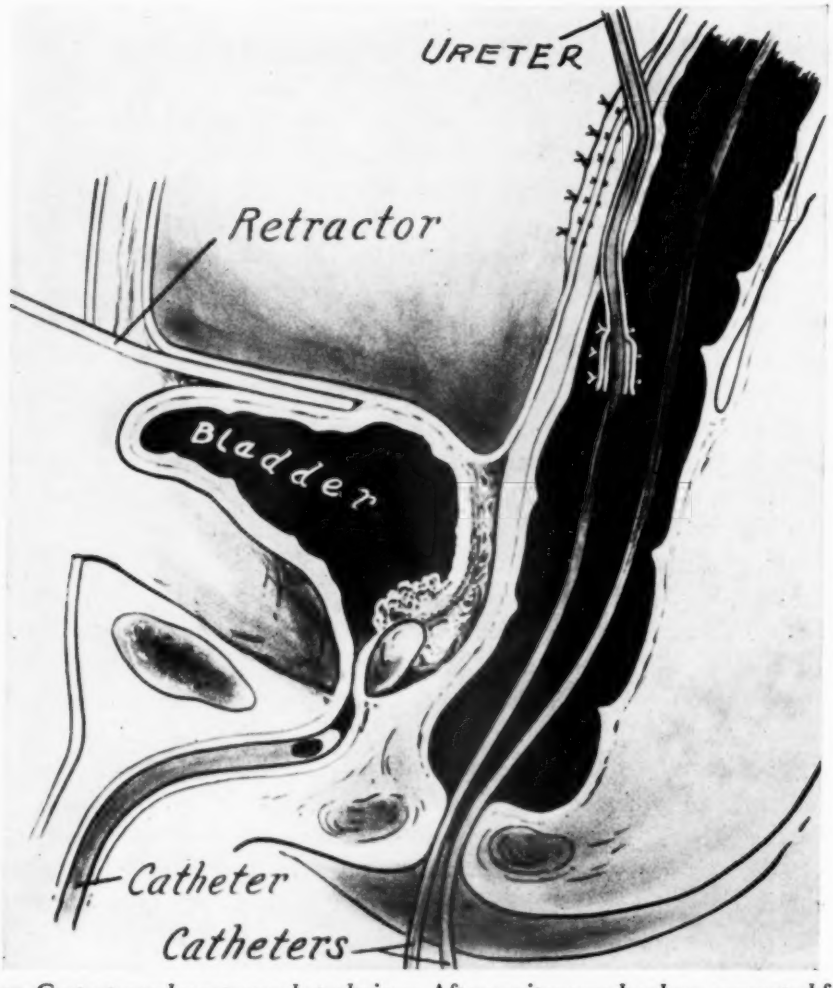

FIG. 10. Cystectomy by retrograde technique. After peritoneum has been separated from fundus of bladder, fingers are insinuated between bladder and pubic bone, one index finger is passed around urethra in front of prostate. Urethra is then severed.[5]

After the completion of the operation, the vesical space was packed with gauze (Fig. 12). By microscopic examination it was determined that the growth was primary adenocarcinoma of the prostate extending into and involving both seminal vesicles (Fig. 13).

The patient made an exceptionally good recovery as indicated by the formal record and in two and one-half months was back at his work. Four

months after operation, he took suddenly ill with a chill and fever, from which he recovered, and went back to work. A month later, he had another illness and died on July 15, 1931 without a doctor being present. No post-

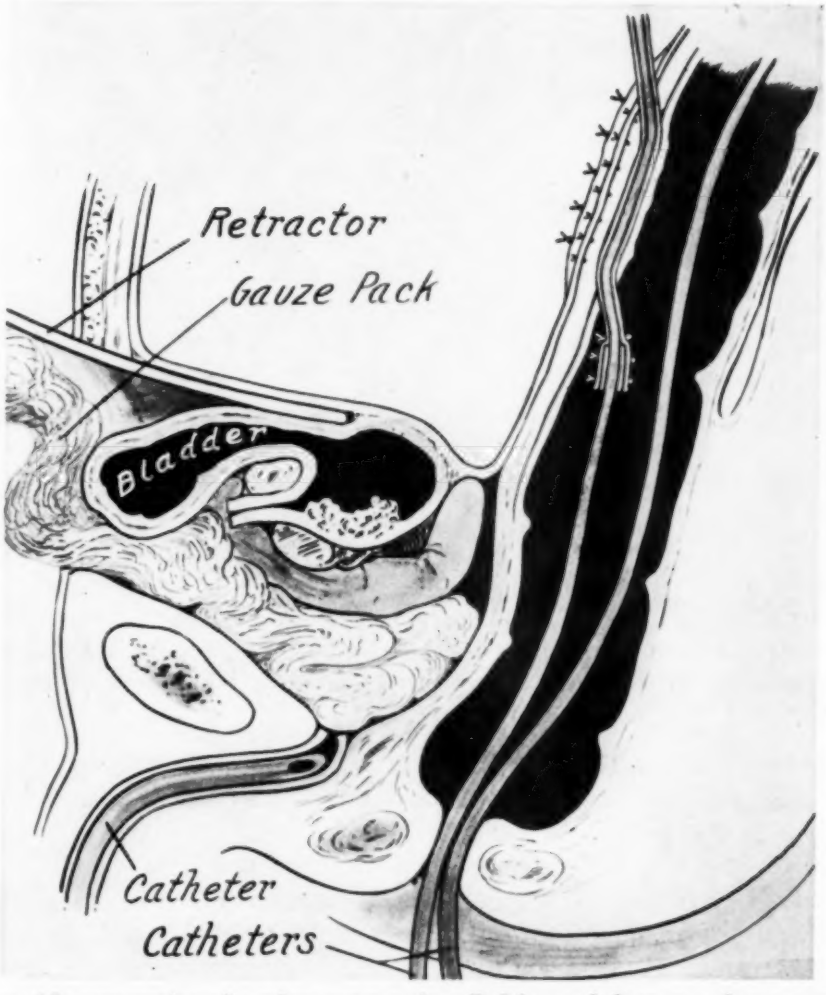

FIG. 11. After separation of urethra, prostate is pulled forward, fingers made to separate prostate and seminal vesicles from rectum from before backward. In meantime all space made vacant by lifting bladder is packed with gauze to control hemorrhage.[5]

mortem was held. His physician, who was away on a trip to Canada at the time of the death, thought he probably died of uremia. There seemed to be some mystery about the case, however, as apparently no physician was present, and no one seemed to know the particulars of his death. Later information obtained from his family indicated that he became melancholic

because of his sexual impotency and possibly might have committed suicide.

CASE IX. W. K., male, aged fifty-four, civil engineer. Referred from

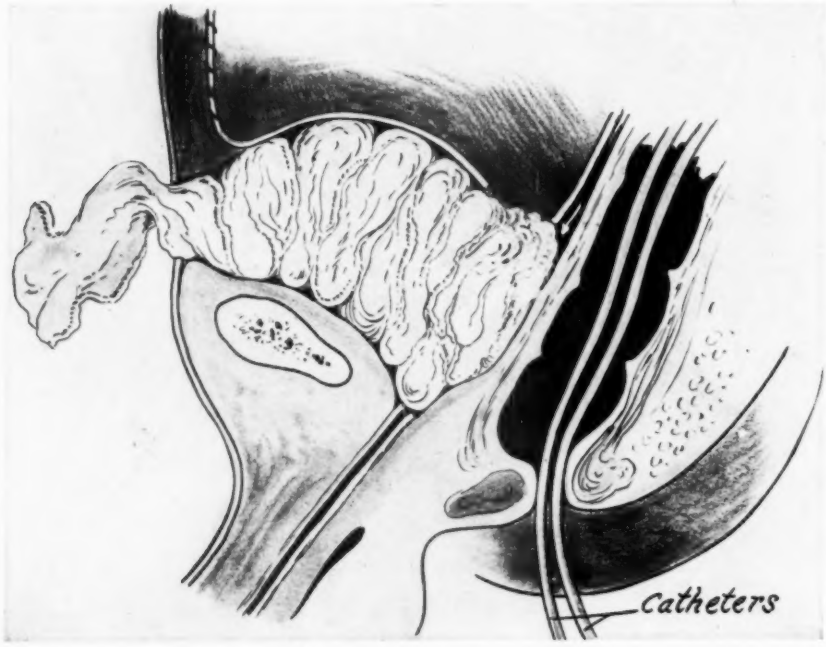

FIG. 12. Gauze packed into vesical space. Arrow indicates drainage tract from retroperitoneal space. An opening is made through peritoneum in bottom of vesicorectal pouch for drainage of peritoneal cavity.

Los Angeles, California. The patient was a resident of Portland, Oregon. The history of the case is as follows: About seven years ago had a hemorrhage from the bladder. At this time he was treated by a Portland urologist. Five years later he had another hemorrhage and was treated again over a period of eight months with irrigations. From time to time he passed shreds of coagulated blood. At this time the diagnosis of carcinoma was made. He then consulted another urologist who confirmed the diagnosis and was unable to give him any encouragement as to the outlook. Having read much in the papers concerning the remarkable effects of the Coffey-Humber treatment, the patient went to Los Angeles to be treated in the clinic there. The obstruction increased and he soon had to consult Dr. Roger W. Barnes, a urologist in Los Angeles, who referred the case to me for ureteral transplantation. In a letter Dr. Barnes gave the following report of his experience with the case:

"Examination January 6, 1931, revealed the bladder to be distended two fingers above the pubis. A catheter passed into the bladder and a small

amount of bladder urine obtained. The bladder, however, could not be emptied because of the catheter becoming obstructed by clots.

"Cystoscopic examination: Irregular cauliflower-like tumor mass cover-

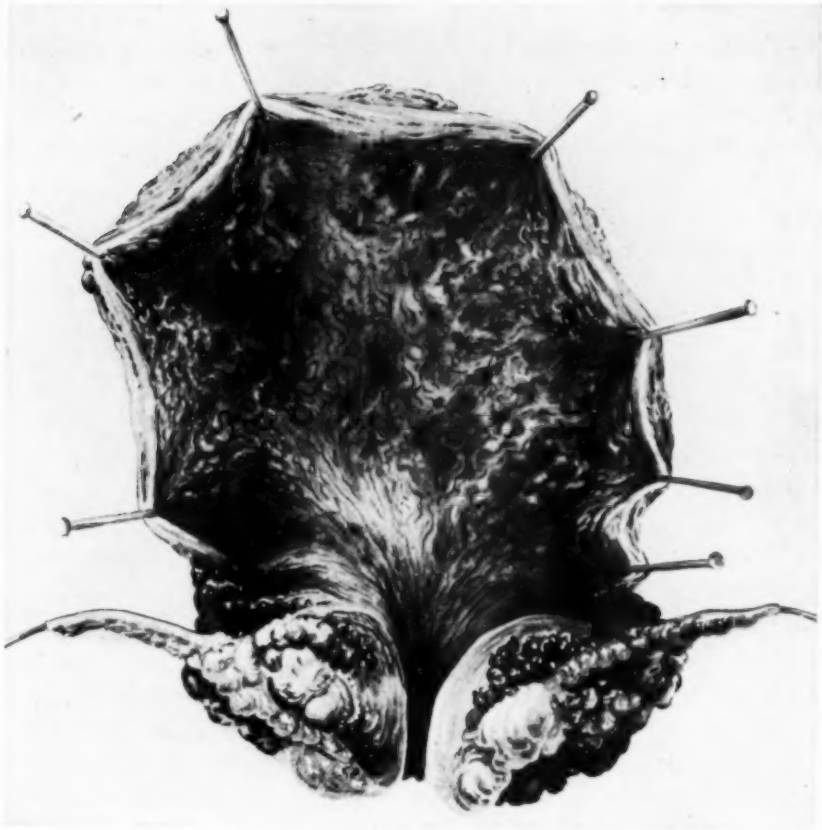

FIG. 13. Primary carcinoma of prostate gland with extension into both seminal vesicles. Case VIII.[5]

ing trigone and left side of bladder wall, extending down to, and involving the bladder neck and some of the posterior urethra. The tumor mass was elevated about 4 mm. above the bladder surface and was roughly 1 cm. wide and extended almost entirely around the bladder neck. There was some ulceration and sloughing in areas and it was covered by a gray membrane. The edges were very irregular. The ureteral orifices were not seen because of the edema surrounding the tumor mass. Diagnosis: carcinoma of the bladder.

"Tumor mass was fulgurated through the cystoscope under a caudal block anesthesia. Following this treatment, the urinary retention was

relieved and the hemorrhage stopped. Since that time hemorrhage has recurred four or five times and each time was stopped by fulgurating the bleeding areas. At each subsequent examination the tumor has been somewhat smaller than at the previous one, and the last examination revealed considerable scar tissue and edema which involved the ureteral orifice.

"He has been taking the Coffey-Humber extract of suprarenal cortex. He has recently had some symptoms of ureteral obstruction, especially on the right side, and for this reason an *x*-ray of the kidneys after injection of uroselectan has been advised."

Our examination confirmed the diagnosis both as to the nature and extent of the growth. Uroselectan revealed no function in the left kidney. The function of the right kidney was normal. The patient was suffering intensely and appeared to be very ill. Having been told of the ureteral transplantation operation, he was very anxious to have it done immediately. In face of the fact that the growth seemed so far advanced, one questioned the feasibility of even a palliative operation but on the insistence of both the patient and his wife, the operation was undertaken with no thought of being able to do more than a palliative ureteral transplantation.

When the abdomen was opened on July 10, 1931, it was noted that the left ureter was dilated to the size of a man's index finger. The pelvis of the left kidney was very much dilated. When the catheters were inserted both kidneys were found to contain dammed-up urine. This was especially true of the left kidney. The right kidney seemed to be normal and the ureter admitted a number 12 catheter. On the left side, the catheter was inserted into the pelvis of the kidney for the purpose of washing it out during convalescence. After the ureters had been transplanted by the tube technique, the patient was still in good condition. There was no evidence of metastasis. The bladder constituted a large nodular mass the size of a man's fist but apparently the growth had not infiltrated into the neighboring tissues. It was then that the possibility of doing a cystectomy first suggested itself, and this only in view of the fact that the patient had no possible chance for his life otherwise.

After the abdominal wound had been thoroughly packed with gauze, the fingers were insinuated between the bladder and the pubic bones and the index finger passed around the urethra. The urethra was then broken with the finger, after which it was possible to dislodge the prostate from below upwards. Gradually the prostate, seminal vesicles and bladder were enucleated and the bladder removed without rupture. It was necessary to tie the vessels and the two lateral ligaments and the vasa deferentia. After removal of the bladder, the vesical space was packed tightly with sterile gauze and the abdomen closed. Before the patient left the table, a transfusion of 600 c.c. of whole blood was given.

The patient left the operating table in good condition and the progress was uneventful until the second day when the abdomen became distended with gas. The distention was very marked and could not be relieved by any

FIG. 14. Carcinoma involving trigone and extending entirely around neck of bladder. Piece of urethra came away with prostate. Case IX.[5]

ordinary means so that the abdomen was opened through the right rectus muscle when it was discovered that the distention was almost entirely in the cecum and transverse colon. Here it was extreme. Careful examination of the abdomen showed no obstruction of the small bowel at any point. There was no evidence of peritonitis. The wall of the cecum was picked up between two Allis forceps. A purse string was passed around an area in the cecum. A trocar was inserted through the bowel wall in this area which permitted the gas in the cecum and transverse colon to escape. The trocar opening was then enlarged and a mushroom self-retaining Pezzer catheter was introduced through this small hole on a probe in the same way that such a catheter is introduced through the urethra. The purse string was

then tied around the catheter near the bulb or mushroom end. Other linen sutures reinforced this purse string so it was impossible to pull the catheter out. The omentum, which was quite abundant, was perforated about its middle. The catheter was then drawn through this hole, after which the omentum was sutured to the intestine by two or three catgut sutures. The catheter was then brought out about the center of the abdominal incision and sutures placed above which fixed the omentum to the abdominal wall. By pressing on the abdomen, the gas in the transverse colon could be backed into the cecum and made to escape through the catheter, leaving the patient's abdomen entirely flat. This technique was first described by Dr. George A. Hendon.[9]

From this time on the patient did well. The catheter kept the patient's abdomen entirely flat. Soon gas began to pass through the rectum and the patient made an uninterrupted recovery. On July 18, the gauze packing was changed. The wound looked healthy. A week later the gauze was again changed and from this time, the wound was treated as described in connection with the previous cases.

Two weeks after the operation, the catheter was cut off near the bulb which was inside the intestine. The bulb passed out through the rectum and the wound healed spontaneously.

Because the patient had been ill so long and had acquired the drug habit, his convalescence was rather painful and slow although his progress was uninterrupted. Finally his pain entirely disappeared, he made a perfect recovery, went back to work and when he very kindly came to report at the Clinic on July 1, 1932, he reported that he was entirely well, able to do his work, and having no difficulty in controlling the urine, and upon rectal examination there was no evidence of any recurrence of the growth. This case is a great triumph as it was so far advanced as to seem almost entirely hopeless. (Fig. 14.)

Case x. M. H. O., male, aged sixty-three, plumbing and sheet metal work. Patient was admitted on October 8, 1931. The history was that he had begun to have bleeding from the bladder in May, 1931. He went to a urologist who discovered a growth in the bladder. A specimen was taken and found to be cancerous. He was then sent to a hospital and had the tumor removed by some form of fulguration through a suprapubic incision. The wound healed nicely but soon the patient began to have blood in the urine again. His distress became greater, and the size of the growth increased rapidly. He was referred to me for transplantation of the ureters as a palliative measure, the thought being that the case was too far advanced for cystectomy.

The operation was performed on October 17, 1931. Extensive carcinoma of the bladder was found. Bilateral transplantation of the ureters by

Technique 2 was done. The ureters were relatively small. The right ureter admitted a number 12 catheter only about 5 inches when a stricture was encountered. This catheter was withdrawn and a number 10 catheter was passed with some difficulty, the ureter holding even this size in a pretty tight grip. The left ureter admitted number 12 catheter rather snugly. The narrow place in both instances seemed to be just above the point of crossing of the psoas muscle. The sigmoid was attached well down in the left iliac fossa by adhesions and was not mobilized but after the ureters were transplanted, its mesosigmoid fitted over the uretero-intestinal anastomosis very snugly. On the right side, the peritoneum was drawn over from the outer side of the posterior or peritoneal incision in the usual way and made to cover the ureter and also the intestinal wound.

The anesthetist reported the patient in fair condition when this had been completed. In view of the fact that the ureteral transplantation was only a palliative operation at best, it was decided to take a desperate chance and remove the bladder. The lower abdomen and pelvis were therefore filled with large packs of gauze. At this time the 95 per cent alcohol which had been injected at the beginning of the operation, and had remained in the bladder for two hours, was drained and the catheter was removed. The peritoneum was then separated from the fundus of the bladder. When this had been separated for a distance downward, the field of operation was transferred to the neck of the bladder and urethra. The bladder was separated from the pubic arch and detached from the abdominal wall at the site of the former cystotomy wound and the fingers were insinuated down to and around the urethra and beneath the prostate. The separation was quite difficult but after a time was accomplished. The urethra was cut, the prostate and seminal vesicles were mobilized and brought forward. Gradually the bladder was detached and removed. The rectum showed a perfectly smooth surface where the bladder had been freed from the fascia covering it. After the packing of the vesical space had been completed, an opening was made in the rectovesical pouch for drainage of the peritoneal cavity into the gauze pack. This opening was an inch or more in diameter. This completed, the omentum was drawn down and interposed between the intestine and the peritoneal partition which separated the abdomen and vesical space. Finally the abdomen was closed and the patient was transfused with 650 c.c. of whole blood. The patient was not seriously shocked. Twenty-four hours after operation, the right catheter was temporarily blocked. I was called but within an hour, a small plug of mucus was detached and the catheter opened.

This patient did well for the first three or four days. On October 22, 1931 about 12:45 P.M., he had a chill and became cyanotic. Temperature rose rapidly from 100° to 103°F. By 2:45 P.M. he had lost consciousness and

died at 3 A.M. the next morning. The kidneys performed perfectly until the last.

A post-mortem was held. The right kidney was normal. On removing the left kidney from its bed, the anterior portion of the fatty capsule revealed an abscess which was not in the kidney substance. It could not be determined whether the abscess had developed before the operation or afterward. The pathologist's report was subacute adhesive pericarditis and endocarditis with chronic myocarditis, marked arteriosclerosis, pulmonary hypostasis, pyelonephritis or perinephritis with an abscess in the capsule of the left kidney.

CASE XI. C. W. P., male, aged seventy, retired real estate man. The patient had been examined by a number of surgeons and urologists. One urologist had removed a small specimen from the bladder for biopsy. This was examined and said to be inflammatory. The patient finally went to a prominent urologist in Tacoma, Washington who made a diagnosis of carcinoma of the right lobe of the prostate. This location would explain the failure of the former urologist to procure a malignant specimen.

The patient gave the following history: Two years ago he had influenza. Since then he has had urinary frequency. At first he would get up once during the night. This increased to two or three times. During the day also there was frequency with some urgency. This too has gradually increased. At present he gets up only once at night and voids perhaps every two or three hours during the day and lately there is dribbling after urination. He has noted too that if he lifts anything heavy or over-exerts himself, blood appears in the urine. After the biopsy he passed a considerable amount of blood in the urine. He has no pain or any great distress. The patient had had some sugar in the urine but this cleared up under treatment. The patient has lost some weight. He is now about 15 pounds underweight. He has had some gastric upsets recently and his appetite has been poor.

Upon careful examination, we were able to confirm the diagnosis of the Tacoma urologist. The patient had carcinoma of the right lobe of the prostate which now extended through the bladder mucosa and protruded into the lumen of the bladder.

This patient was operated upon on December 15, 1931. Inasmuch as a biopsy specimen had been taken at another clinic and malignancy had not been found, it was thought imperative to open the bladder and take a specimen for microscopic examination before proceeding with the transplantation and cystectomy. The bladder was distended with water and its musculature exposed and picked up between two Allis forceps, after which the water was allowed to escape through the urethral catheter. The bladder was then opened and the protruding portion of the growth excised. Examined

microscopically after frozen section, it was found to be an adenocarcinoma indicating that it had originated in the prostate (Fig. 15). The bladder was dried as well as possible and packed with gauze. Ninety-five per cent alcohol

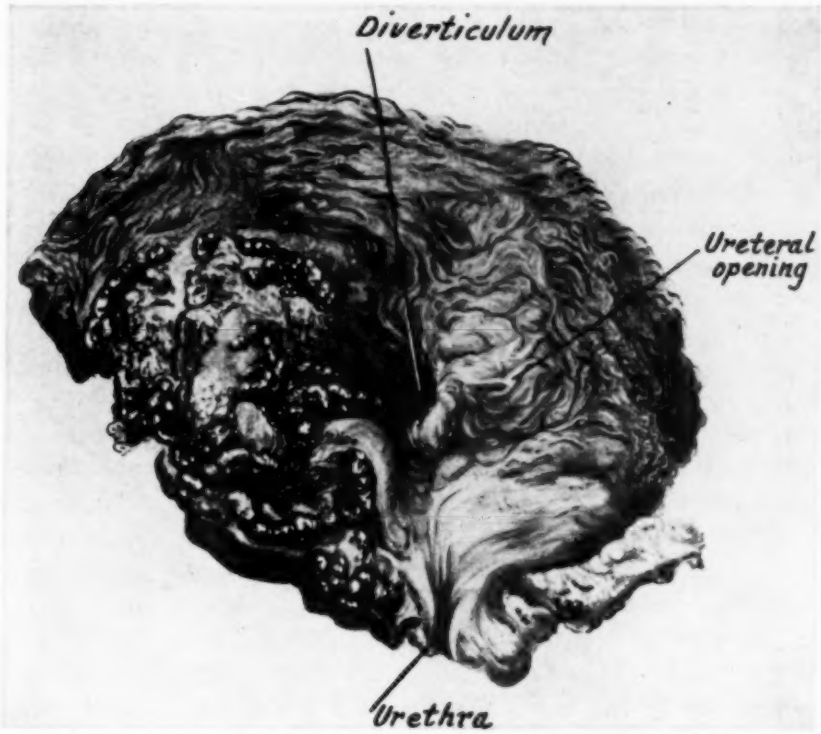

FIG. 15. Adenocarcinoma of bladder originating in right lobe of prostate. Case XI.

was poured into the gauze for its antiseptic action while the transplantation of the ureters was performed.

The incision was extended and the peritoneal cavity was opened. The kidneys were examined and found to be quite normal in size. There was no hydronephrosis, but some dilatation of the right ureter. The left ureter was normal. The transplantation operation was then performed according to Technique 2 rather high on the sigmoid. Number 12 catheters were used. When the transplantation operation had been completed, the bladder was removed. First the peritoneum was freed with scissors from the fundus of the bladder. The bladder was then separated from two sides and in front. The index finger was hooked around the urethra, the prostate lifted from its bed and the urethra broken after which the bladder was gradually separated from its bed. It was removed in about fifteen minutes. It was removed in toto with the seminal vesicles, the intact prostate, the ureteral stubs and the vasa deferentia. About ½ inch of the membranous

urethra came with the prostate. The pack which had been put in temporarily was now removed. Bleeding was not severe but a fresh clean pack was introduced into the vesical space. The rectovesical space was opened so as to permit drainage from the free peritoneal cavity. Rubber tissue was also inserted across the opening and above the gauze so that if any loop of bowel should come down, it would come against rubber tissue instead of gauze. After the bladder space had been packed, the gauze packs in the abdomen were removed. The omentum was drawn down and interposed between the pelvic colon where the ureters had been transplanted and peritoneum which had covered the bladder.

The execution of the operation was very satisfactory. Not a large amount of blood was lost but the patient was given 450 c.c. of blood by transfusion. The patient was not shocked by the operation. When the patient left the table, there was no discharge of urine from the catheters but urine began to flow shortly after the patient was put in bed and there was no trouble in this regard afterward.

This patient, in addition to being seventy years of age, was also an asthmatic and the day after the operation he developed a severe bronchorrhea which was so serious that the patient had to be kept in an oxygen tent for more than three days. After this, recovery, while slow, was uninterrupted and the patient on July 1, 1932 was able to come to the Clinic. He reported that his health was rapidly becoming normal in that he was gaining strength and that he had no difficulties with the urine in any way. A letter dated November 22, 1932, practically a year after the operation, states that the patient is in normal health at the age of seventy-one and has no discomfort whatever.

SUMMARY

Eleven cases of cystectomy for cancer of the bladder are herein reported. Of the 11 cases, there were 3 surgical deaths, or 27.27 per cent mortality.

In 2 cases, women on whom the operation was done in two stages, first ureteral transplantation, second cystectomy, the patients are alive and well. Two women with far advanced carcinoma of the bladder which had been treated on numerous occasions by radiation and fulguration, died as a result of an attempt to do the combined operation of transplantation and cystectomy at one sitting. In one of these cases it was poor judgment to do an operation at all. The difficulties encountered in these 2 cases revealed special problems which indicate that

the combined operation is impractical in women, even if the cases are favorable for operation.

In seven men the cystectomy was performed with transplantation of the ureters at the same operation. Of this number, there was one surgical death, 14.28 per cent. One patient died five and one-half months after operation without the presence of a doctor and evidence obtained from the family indicated that death may have been due to something entirely foreign to the operation or to the disease. The other 5 men are alive and well. All have been seen or heard from within a month of the presentation of this paper. All have been examined within five months.

We are now able to report 7 symptomatically cured patients following cystectomy for cancer of the bladder with no evidence of recurrence four years, six months; three years, four months; two years, nine months; two years, five months; two years, four months; one year, six months and one year respectively after operation. Aside from being perfectly well and comfortable, these patients are unusually happy and well satisfied with the results as contrasted with patients afflicted with carcinoma of the rectum who are frequently more or less morbid because of the inconvenience of a colostomy opening. This spirit of optimism and gratitude was recently manifested when six of the seven living patients came from their homes, some of them long distances, to present themselves for examination and questioning at a clinic held for the western division of the American Urological Society, July 1, 1932. These patients were all very happy to come and pay their own expenses. One of them came more than 700 miles to be present. The one who did not come was more than a thousand miles away.

These results compare favorably with the results of treatment of cancer in any other part of the body. Indeed, this very limited experience coupled with the knowledge that as a rule cancer of the bladder remains a local process for a long time before it metastasizes, leads one to hope that cancer of

the bladder may yet be the most curable of all the cancers which invade the body, and that the operation, with added experience, performed at an earlier stage of the disease will be no more formidable than any of the other major operations for internal cancer.

One may very pertinently ask: "What is the state of the kidneys after ureteral transplantation?" Several hundred patients are now living upon whom transplantation of the ureters into the large intestine by the submucous implantation method has been done. Many different surgeons have employed this operation during the last twenty years for various conditions. Intravenous urography and blood chemistry have put into the hands of the profession accurate agencies of investigation. Many cases have been thus carefully studied subsequent to transplantation. In some of these, normal kidneys and ureters have been demonstrated and the patients are in perfect health. In others, a variable amount of dilatation of the ureters and pelves of the kidneys is found and yet the blood urea is not elevated and the patients are in perfect health. In still other cases, decidedly damaged kidneys, increased blood urea, low visualization by intravenous urography are revealed and still the patient is seemingly in good health. It is noteworthy that the condition of the patients in this latter class tends to improve as the years go by, so that from the standpoint of the physical state of these patients as manifested in ordinary life, most of them may be considered normal in health. It is well to consider and discuss these purely urological matters when dealing with ordinary fistulae occurring in young women but the discussion is not so pertinent when we are dealing with cancer of the bladder.

The problems involved in the treatment of cancer of the bladder vary in the two sexes. The generative organs in the female separate the transplantation operative field and that of the cystectomy so that it is necessary or at least advisable to do the operation in two stages. At the first operation the ureters are transplanted, the uterus and broad ligaments are

stitched to the anterior parietal peritoneum and the quarantine drain is placed in the pelvis. This insures that the cystectomy operation to be performed later will be entirely extraperitoneal. Because the bladder is thus walled off from the peritoneal cavity and also because the vaginal canal intervenes between the rectum and bladder, tremendous doses of radium may be used within the vagina as well as within the bladder without doing damage to other organs. The radium may be used within a few days of the transplantation operation and will at least hold the cancer in check until a favorable time for doing cystectomy. In some cases, no doubt, such heroic doses as will be possible in this way may produce a permanent cure. Impressions gathered on a recent visit to the Curie Institute in Paris, however, deepen the conviction that cancer of the bladder is rarely cured by radium and should be classed as a surgical disease, even in women. For, notwithstanding the unfortunate results in two of the cases reported, the operative mortality in women should be no higher than in men if the operation is done in two stages.

In the operation for cancer of the bladder in the male, the anatomical fields of ureteral transplantation and cystectomy are intimately connected. The cystectomy can be performed much more easily while the abdomen is wide open for ureteral transplantation than at a second operation when a small incision made through a recently healed operative field makes the operation much more difficult and less thorough. The gauze pack, furthermore, which fills the vesical space after the bladder has been removed also drains the area of the transplantation and thus avoids intraperitoneal drainage.

The objection has been raised that the operation of bilateral transplantation of the ureters by Technique 2 is too complicated for general use. It will be conceded that it is quite a formidable operation. Urology is possibly the most highly developed of the major specialties and carcinoma of the bladder is susceptible of very early diagnosis by a skilled urologist. The fields of specialism have been so sharply defined in recent years that a

most distinguished urologist may be unskilled in the practice of intraperitoneal surgery. The result is that he is loath to abandon the more conservative measures in treating carcinoma of the bladder for a very radical operation fraught with danger. An effort has been made therefore to develop a transplantation operation which is simple and safe enough to justify the use of radical means at an early and hopeful stage of the disease. Technique 3, while yet in the experimental stage, gives considerable promise in this regard.

EXPERIENCES WITH TECHNIQUE 3

Three cases operated upon by Technique 3 have been reported in some detail,[10] one of which was borrowed from Dr. Harold Brunn of San Francisco. On September 22, 1932, I performed another operation in Dr. Nesbit's Clinic at the University of Michigan Hospital, transplanting one ureter. A few days later, Dr. Nesbit did the operation on another patient, transplanting one ureter. In a personal communication he reports that in each case a ureterorectal fistula was established in three days and that the patients made uneventful recoveries.

Since my report of the 3 cases mentioned, I have operated upon another patient, four years of age, by the transfixion suture technique for exstrophy of the bladder. The ligature cut through in the first ureter within thirty-six hours. The second ureter was transplanted thirty days later and the ligature cut through very soon afterward. There were no untoward symptoms in this case.

Dr. A. B. Hepler of Seattle reported a case at the meeting of the North Pacific Surgical Association December 3, 1932 in which he had transplanted the ureters at two operations. He showed roentgenograms of the kidneys and ureters which had been taken by intravenous urography. The result was perfect.

Thus, the transfixion suture operation, Technique 3, has been performed in 7 cases of exstrophy of the bladder in chil-

dren. In the 7 cases to date, twelve ureters have been transplanted. In all the cases the ureterorectal fistula has been established within three days or less and in only one case have there been any untoward symptoms following the operation. This misfortune was rectified by a second operation. However, there have been some other reports which have been disquieting.

Dr. Gonzalo Pedroso of Havana, Cuba, in a personal letter reports 3 cases in adults. In one of these it required six days for the transfixion suture to cut through the first ureter. Mr. Cyril A. R. Nitch, senior surgeon to St. Thomas's Hospital, London, in a personal communication reports one case in which the suture had not cut through in twelve days. He doubts whether the operation is suitable for adults. This doubt is also raised by the same author in a paper read before the Royal Society of Medicine,[11] February 25, 1932 and at the same meeting discussed by Mr. C. R. Walker-Taylor of Sydney, Australia in the following words:

> In reference to Coffey's transfixion suture technique, Mr. Nitch has suggested that with a thickened ureter, such as is often encountered in these cases, the rectal mucosa would cut through long before the ureter. To avoid this, I suggest a modification: Include in the transfixion stitch a small metal ring in the rectum, on which traction could be made to ensure cutting through the ureter.

I think that this is an excellent suggestion and I am very grateful to Mr. Walker-Taylor for it.

I have found it rather difficult at times to determine whether the needle had actually penetrated the intestinal lumen. All doubt would be removed by the application of the suggestion of Walker-Taylor to include an intra-intestinal object in the bite of the transfixion stitch. The metallic ring seems to be a good arrangement but Walker-Taylor does not mention a method of introducing it to the site of operation.

I have devised an olive-tipped forceps[6] for the purpose of carrying a ring or other intra-intestinal object to the point of incision in the intestine. It works satisfactorily in the animal but I have not yet used it on the human patient. Dr. Reed M.

Nesbit of Ann Arbor in a personal letter to me has reported an unfortunate experience in the application of the metal ring to which was attached a traction loop. It is a question as to whether it is entirely devoid of danger. Notwithstanding the unfortunate experience in adults reported by Nitch and Pedroso following the simple transfixion suture, I am of the opinion that if the suture is tied sufficiently tight and particularly if two sutures about 1/32 inch apart are used, there is no occasion for using an intra-intestinal object.

The points which are vital to the success of the operation are:

(a) The transfixion suture must penetrate the lumen of the ureter.

(b) The transfixion suture must penetrate the intestinal mucous membrane.

(c) The transfixion suture must be tied sufficiently tight to cut through all the tissues in its bite.

(d) The ligated end of the ureter should be anchored by a separate catgut suture to the muscular and peritoneal coats of the bowel.

But, in discussing the question of cystectomy, I think it is just as well for the present to eliminate the transfixion suture method until we have had further experience with it.

CONCLUSIONS

Cystectomy for cancer of the bladder is probably one of the most successful operations that has been introduced into the domain of surgery for the treatment of cancer, for the reason that diagnosis is early while metastasis is late and with added experience, the mortality rate undoubtedly will be low and the curability high.

An essential part of the operation is transplantation of the ureters into the large intestine. This, to be successful, must be performed by the submucous implantation method.

Of the three principles of technique which have been proposed for its performance, Technique 1 may be eliminated

at once. Technique 3, because of its simplicity, may be favored by some in early cases of cancer of the bladder in which the element of time is not important. For the same reason, it may encourage radical operation early in the disease as is done for cancer in other parts of the body. The chief criticism is that two operations are required for the transplantation of the ureters. Technique 2 is ideal for use in conjunction with cystectomy for cancer of the bladder for the reason that the two ureters are transplanted in one operation. In the male cystectomy is performed at the same time the ureters are transplanted with little or no additional risk. The one objection that may be offered to this technique is that it requires special skill in the performance of intraperitoneal surgery. Moreover, it does not lend itself to animal experimentation whereby skill could be improved.

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DISCUSSION

Dr. Rudolph Matas, New Orleans, La.: I cannot refrain from saying something in appreciation and praise of Dr. Coffey and his work. For years we have watched him as he has perseveringly and progressively pursued his experimental and clinical studies in ureteral transplantation in the laudable effort to make this a practical, well defined and safe procedure.

By improving on the work of his many and distinguished predecessors, he has finally perfected a technique which marks the culminating point of nearly a century of effort to solve a most important but difficult surgical problem. In the fine paper that we have just heard, he has demonstrated by the success and relative simplicity of his method of submucous ureteral transplantation into the colon, that the total extirpation of the urinary bladder has been made a feasible working procedure, thereby opening a new field of surgery which had been hitherto regarded as prohibitive.

Those who have had much experience with exstrophy of the bladder and with tuberculous and cancerous disease of this organ will realize at once what a boon a radical cystectomy, made safe by ureteral transplantation, will mean to these pitiable sufferers. I can speak sympathetically on this subject because in the late nineties I was interested in the problem of exstrophy of the bladder and did considerable experimental work in ureteral transplantation by the Maydl technique which was then the most promising procedure. I reviewed the subject and reported my experiments with the Maydl operation and other modifications.*

The constant menace of ascending urinary infection kept me from adopting it. Now, quite apart from the indications furnished by exstrophy and other malformations of the bladder, we may expect to relieve intractable vesicovaginal fistulae, malignant tumors of the bladder and especially tuberculous cystitis, which no form of palliative treatment usually relieves. I have in mind the case of a boy suffering from tuberculosis of the bladder in which I did a bilateral nephrostomy which gave rest to the bladder, but compelled the boy to wear two urinals attached to his back. In another case, the ureters were transplanted to the skin of the lumbar region, causing all the discomforts of a bilateral urinary fistula.

The indications for ureteral transplantation by Coffey's method are increasing rapidly and the results are most gratifying as we read them in the current literature.

*J. A. M. A., July 29, 1899.

DR. ROBERT C. COFFEY (*Closing*): There is another thing that is being done that I did not mention. Some operators have transplanted both ureters in bilateral renal tuberculosis. I have never had the courage to do that. Dr. Peacock of Seattle has done it in one or two cases with very gratifying results. Someone in Florida, whose name I cannot for the moment remember, has performed two or three of these operations. I do not recommend it but the procedure has been successful in their hands. Dr. Peacock believes that the rectum is very resistant to tuberculosis and therefore is not likely to become infected. If this proves to be the case, it will be a great boon to these sufferers.

TUMORS OF THE PARATHYROID GLAND

REPORT OF TWO CASES

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LEXINGTON, KY. ROCHESTER, MINN.

THE privilege of recognizing a new clinical entity is seldom afforded our generation. Although the acuity of our predecessors has precluded many such possibilities, it was not until the present century and comparatively recent years that hyperparathyroidism, most typically represented by tumors of the parathyroid glands, was revealed as a distinct clinical syndrome presenting clearly defined physical and laboratory characteristics. In accord with the recent evolution of this disease, it is not surprising that its diagnosis is largely dependent on laboratory data. Of greatest single importance is the roentgenologic evidence of the osteitis fibrosa cystica type of bony involvement, associated with which chemical studies of the blood and history of the illness usually suffice to render the diagnosis certain. The immediate purpose of this paper is to present two cases in which operation was performed by one of us (Rankin), and in which the diagnosis of hyperparathyroidism was made and the tumors were extirpated. The first case, which was the first in which operation was performed in The Mayo Clinic, was reported in detail by Wilder in 1929, but the follow-up studies seem to warrant a brief epitome of the subsequent course. The second case presented several unusual features and the postoperative convalescence and outcome were of particular interest.

HISTORICAL SKETCH OF DEVELOPMENT OF KNOWLEDGE OF THE SUBJECT

Knowledge of the disease now known as hyperparathyroidism dates originally from von Recklinghausen's description, in 1891, of certain bony abnormalities termed by him "osteitis

fibrosa," and from Erdheim's observations on the association of hypertrophied parathyroid glands with this type of skeletal change. Erdheim originally considered that the enlargement of the parathyroid bodies was secondary and compensatory to the bony changes. This idea was not definitely disproved until Mandl, in 1925, working in Vienna, had the opportunity of making clinical trial. He had under his care a patient who presented advanced osseous dystrophy, and enlargement in the region of the thyroid gland. He first successfully engrafted four normal parathyroid bodies, quickly obtained from the victim of an accidental death, into the abdominal wall of his patient. Although the transplants flourished, the patient failed to improve. This led him to explore the neck surgically and to remove a parathyroid tumor, with marked beneficial result to the patient. Gold presented a similar case two years later.

The disturbance in chemical phenomena associated with hyperparathyroidism apparently was noted first by Jacoby and Schroth in 1912, who detected excessive urinary excretion of calcium by a patient suffering from this type of disease. About this same time Greenwald noted a relationship between the parathyroid glands and the metabolism of phosphorus, finding markedly decreased excretion of the latter by parathyroidectomized dogs. The greatest impetus to the study of these glands came when Hanson, in 1924, and Collip, in 1925, discovered an active parathyroid extract. Following their announcement many investigators conducted laboratory researches in experimental hyperparathyroidism, and finally produced the typical clinical picture in rats, rabbits and other animals. Outstanding in this field were the works of Bauer, Albright and Aub, Wilder, Johnson and Jaffe and Bodansky. Clinically, during the last few years, Hunter in England and Wilder in this country have contributed to understanding of this subject. Ballin has had large experience with operation on the parathyroid bodies and has broadened his indications for surgical extirpation of the glands beyond the classical cases characterized by the osteitis fibrosa cystica type of skeletal changes and the altered

metabolism of calcium and phosphorus. Camp and Ochsner have described the pathognomonic roentgenographic findings in the typical cases.

DIAGNOSTIC CRITERIA

We have limited ourselves, in surgery of the parathyroid glands, to those cases which present the typical syndrome now recognized as hyperparathyroidism. Our standards of diagnosis entail the presence of certain definite diagnostic criteria: (1) usually a prolonged history of skeletal pain, weakness often confining the patient to bed, and perhaps one or more fractured bones; (2) definite roentgenographic evidence of generalized bony decalcification usually manifested as osteitis fibrosa cystica involving numerous bones, if not the entire skeleton; (3) a normal or elevated amount of calcium in the blood serum, associated with increased excretion of calcium, giving a negative calcium balance, and (4) a normal or decreased level of phosphorus in the blood serum with an excess excretion of phosphorus resulting in a negative balance for this element. In addition, certain secondary findings are commonly present, the most prominent of which are weakness, generalized myotonia, anemia, loss of weight, and disturbances of the gastrointestinal tract. Nephrolithiasis is a rather common associated finding. Palpation of an enlargement in the region of the thyroid gland adds presumptive evidence to the diagnosis; however, it is not essential to the typical clinical picture, for the parathyroid tumor may be small, and concealed by the thyroid gland, or it may be aberrantly situated. In our more recent case, the value for serum phosphatase was found to be greatly elevated.

The roentgenographic findings in cases of hyperparathyroidism are perhaps the most pathognomonic of any laboratory data and, in fact, often afford the first clue to accurate diagnosis. Roentgenograms of the different skeletal members in cases even vaguely suggestive of this disease will aid greatly in the detection and earlier recognition of this disease. The typical roentgenologic evidence is that of generalized

osteoporosis, cystic lesions, and deformities. As stated by Camp and Ochsner:

> The generalized osteoporosis is characterized by a miliary or granular appearance. This change is best observed in the skull, and appears to be peculiar to hyperparathyroidism. In addition, the bone trabeculae and cortical bone are thinned, and areas of subperiosteal absorption are seen in the long bones and phalanges.

Of the two cases to be presented in which parathyroid tumors were removed, the first one is fairly typical of the syndrome we now recognize as hyperparathyroidism, although marked hypercalcemia was not present prior to operation. The second case presented many atypical features which added materially to the complexity of the postoperative treatment and ultimately presented a therapeutic enigma resulting in death.

REPORT OF CASES

CASE 1. A woman, aged thirty-four years, came to the clinic first January 13, 1925, complaining of difficulty in swallowing and pain in the right hip. Except for moderate anemia, and what was taken to be a small adenoma in the thyroid gland, no definite pathologic process was discovered. The basal metabolic rate was +12. A diagnosis was made of hysterical dysphagia, which condition yielded readily to esophageal dilatation.

The patient returned to the clinic in April, 1926. She was confined to bed and complained of generalized bodily pains which were accentuated on motion. The pains were most severe in the hips, knees and arms. The value for hemoglobin was 75 per cent and leucocytes numbered 8000 in each cubic millimeter of blood. The value for calcium was 11.2 mg. and for phosphates 1.4 mg. in each 100 c.c. of blood. Roentgenologic studies suggested multiple metastasis in the lumbar portion of the spinal column, pelvis, left femur and calvarium. Roentgenologic studies of the thorax, stomach and colon were negative. Following hospitalization and study, the diagnosis was finally made of prolonged nutritional deficiency resulting in osteoporosis, anemia, and questionable lateral sclerosis. The patient was given a high calorie diet, cod liver oil, yeast, sunshine, heliotherapy, and so forth, with sufficient improvement and gain in strength to permit of her walking. During the interval of this observation, biopsy of the left femur revealed "inflammatory tissue." At this time the calcium and phosphorus balances were definitely positive, which might be explained by the

treatment. Having improved considerably, she was dismissed from our care on expectant treatment.

She returned again in November, 1928, complaining of severe pain,

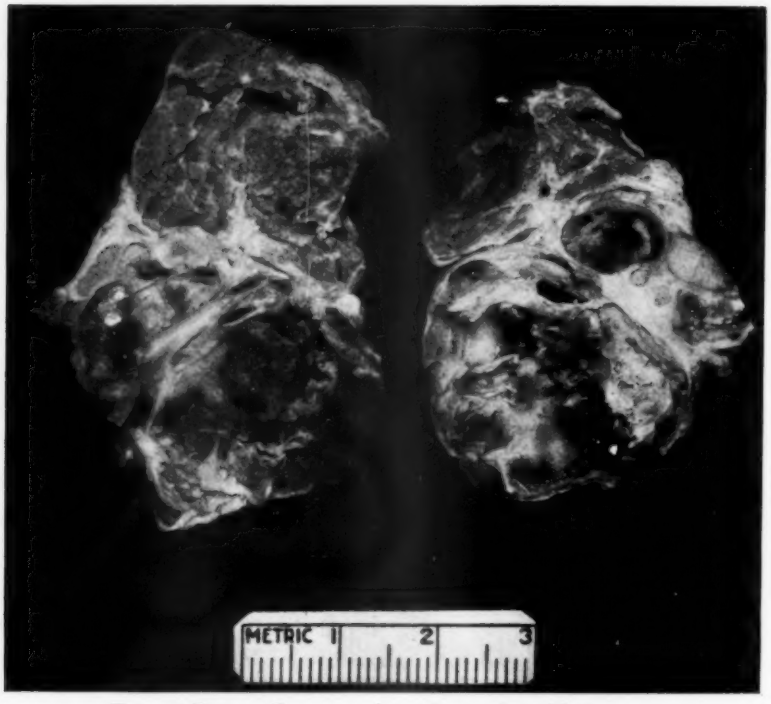

FIG. 1. Case 1. Gross section of parathyroid tumor.

especially in the right knee. She had continued her treatment with the high calorie diet, and the taking of phosphorus and calcium by mouth. Physical examination at this time again revealed a small node at the right lower pole of the thyroid gland. Again, roentgenographic studies disclosed cystic areas of rarefaction in the lower right femur and pelvis and multiple areas of absorption throughout the skull. The patient was hospitalized and studied. Examinations of blood and urine gave negative results. The value for blood calcium was 12.2 mg., and for blood phosphorus, 1.2 mg. During this visit the similarity of this case to the one reported by Barr, Bulger and Dixon was noted. The basal metabolic rate was found to be +21.

Operation was performed December 17, 1928, and partial thyroidectomy, with resection of the right lobe and removal of the isthmus, was performed. A tumor about 6 cm. in diameter, simulating a hemorrhagic goiter confined to the right lobe and the isthmus, was removed. The tumor was situated substernally and proved to be composed of multiple hemorrhagic, cystic, parathyroid adenomas which on further study appeared to

be malignant adenomas. The left lobe of the thyroid gland was elevated and explored posteriorly but nothing of note was found (Figs. 1 and 2).

The immediate postoperative convalescence was smooth. The value

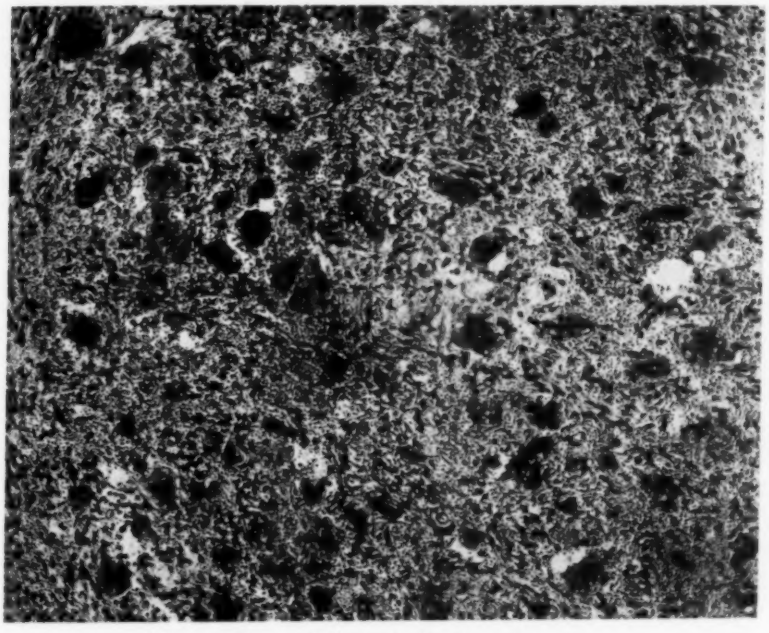

FIG. 2. Case 1. Microscopic view of tumor.

for blood calcium fell on the following day to 9 mg.; then went as low as 7.1 mg., at which time premonitory signs of tetany appeared but yielded satisfactorily to administration of calcium phosphate by mouth. The value for serum calcium soon returned to normal, and was 8.4 mg. at the time of dismissal of the patient twenty days following operation. Excretion of calcium was likewise within normal limits. January 7, 1929, when she left the hospital, the patient was able to walk without pain. She looked well, had gained weight, and was in excellent spirits. She was sent home with instructions to follow a high calorie and high vitamin diet, and continued to improve. April 4, 1929, we had an opportunity to reexamine her and she was found to be much improved. She had no complaints; she had gained weight and walked with ease. Roentgenographic examinations gave evidence of some increased density of the bones. The value for blood calcium averaged 8.3 mg. on three determinations and that for blood phosphorus, 1.7 mg. Her general condition was found to be excellent (Figs. 3 and 4).

CASE II. A woman, aged forty-seven years, first came to The Mayo Clinic September 8, 1930, complaining of generalized weakness, stiffness in

the knees, and lancinating pains in the back and along the course of each sciatic nerve. She had been bed-ridden for two years.

Physical examination revealed that the patient was poorly nourished

FIG. 3. Case 1. Roentgenogram of skull prior to operation.

and anemic. She was confined to bed, and had evident discomfort on the slightest motion. She weighed 100 pounds (45 kg.) and her blood pressure was 90 mm. Hg systolic and 54 diastolic. The urine was normal. The value for hemoglobin was 50 per cent; erythrocytes numbered 3,500,000 and leucocytes 7400, in each cubic millimeter of blood. The concentration of gastric acids was within normal limits. Roentgenographic studies gave evidence of marked osteoporosis of practically all bones and an incomplete fracture of the anterior surface of the sacrum, which suggested hyperparathyroidism to the roentgenologist; however, the correct diagnosis was not made at this visit. Carcinomatous metastasis could not be excluded, although no primary lesion was localized. The value for blood calcium ranged from 8.6 to 10.1 mg. in each 100 c.c., and that for blood phosphorus,

from 1.6 to 3.6 mg. on repeated estimations. (We have since learned that elevated values for blood calcium and lowered values for serum phosphorus are not essential to the diagnosis of hyperparathyroidism.) The patient

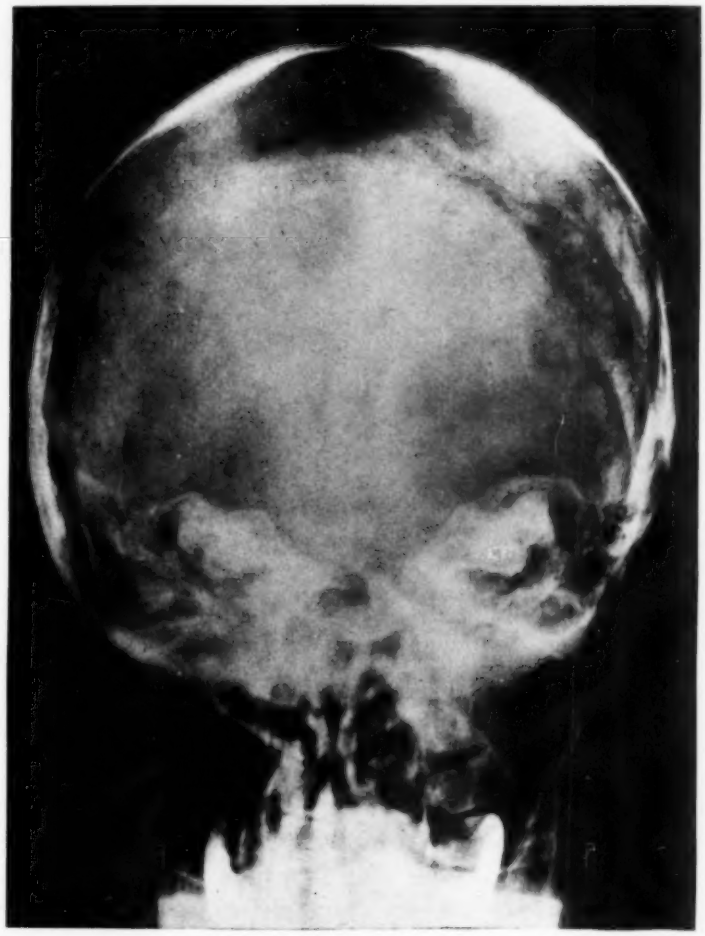

FIG. 4. Case 1. Roentgenogram of the skull eighteen months following operation.

was given a series of roentgen treatments, and with the recommendation to follow a diet high in vitamins she was permitted to return home.

During the interval at home temporary improvement took place. On the patient's return, May 30, 1932, she complained of severe intermittent cramps in her legs, especially the right, which were initiated by the slightest stimulus. She was extremely weak and was confined to bed in a constant state of discomfort.

Moderate secondary anemia was present; the urine was normal. Roentgenographic studies of the pelvis and lumbar part of the spinal column

gave evidence of marked osteoporosis affecting all bones. This was considered indicative of hyperparathyroidism. There was a pathologic fracture of the left femur. The value for blood calcium ranged from 10.6 to 11.8

FIG. 5. Case 11. Parathyroid tumor.

mg. during a period of two weeks' observation, and the blood phosphorus from 2.3 to 3.0 mg. The value for blood phosphatase at this time had reached 61.7 units. Although marked hypercalcemia and greatly increased excretion of calcium, usually present in these cases, were not demonstrated, the high level of the serum phosphatase supported the diagnosis of hyperparathyroidism. In addition, a definitely negative balance for calcium was demonstrated, with a daily loss of 0.2 to 0.24 gm. Although a definite tumor was not palpable in the neck, exploration of the parathyroid bodies seemed justifiable.

Operation was performed June 16, 1932. When the thyroid gland was exposed it appeared quite normal, except for what was taken to be a small tumor in the upper pole. This was removed by resection of the pole but was found to be an adenoma without any evidence of parathyroid tumor. (This point illustrates the difficulties sometimes of finding parathyroid tumors when they are extremely small.) Careful examination of the gland did not reveal any evidences of a parathyroid tumor. However, having explored the ordinary situations of parathyroid tumors, we rotated the gland mesially, divided the right inferior thyroid artery, and brought into view a tumor measuring about 4 cm. in diameter which was lying well in

between the trachea and esophagus. It was a bluish, soft tumor, characteristic of parathyroid tumor. This was removed and was reported to be a parathyroid adenoma (Figs. 5 and 6). The left side was explored, was

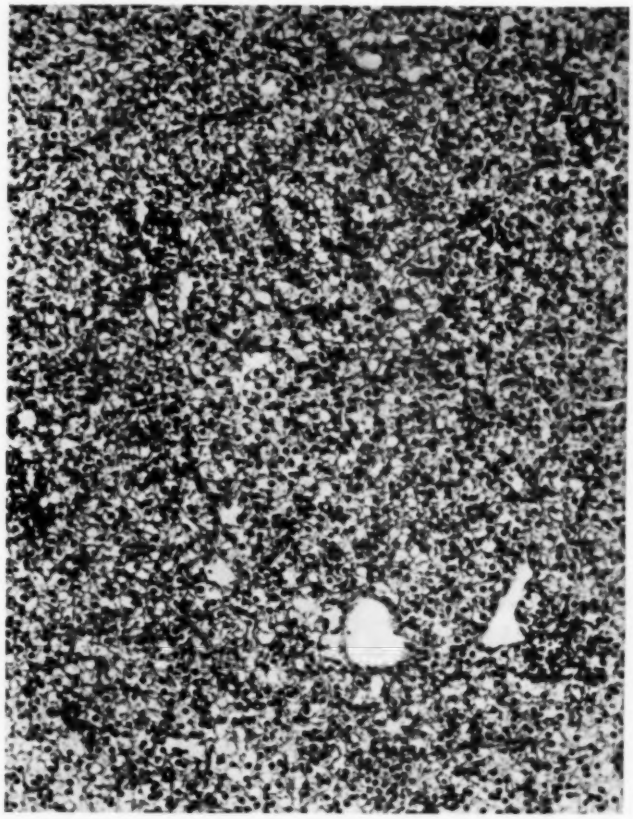

FIG. 6. Case II. Histologic appearance of tumor.

found to be normal and was left undisturbed. At the same time a Thomas splint was applied to the fractured left leg.

Following operation, the patient was in good general condition and the value for blood calcium promptly fell to 7.5 mg. It continued to fall, and on the fifth day after operation reached a low level of 4.6 mg., at which time definite evidence of tetany developed, despite previous administration of calcium. Parathormone averted development of this and the subsequent use of calcium lactate prevented further tetanic manifestations. Concomitant with the drop in serum calcium, the value for serum phosphatase decreased to 22 units. The calcium balance became positive, and the outlook was now bright. However, our hopes were short-lived, for extreme nausea and vomiting, associated with abdominal cramps, distention, and

diarrhea developed in the fourth postoperative week and rendered adequate nutrition an extremely difficult problem. The calcium balance again became negative, and the amount of calcium in 100 c.c. of blood fell to 6.2 mg.;

FIG. 7. Case 11. Roentgenogram of upper end of left femur showing old pathologic fracture.

tetany occurred, and was relieved only by intravenous administration of parathormone and the giving of calcium lactate by mouth. The value for blood phosphorus also had fallen to 1.0 mg.

From this time on the patient failed gradually, despite all efforts. For the last six weeks of life there was practically daily emesis, and nourishment consisted almost entirely of intravenously administered solution of glucose. Nutritional edema developed, and abdominal cramps, at times thought to be due to tetany, were frequent. The value for blood calcium ranged from 11.4 mg. down to 7.5 mg., and back to 10.8 mg. at the time of death on the seventy-eighth postoperative day. The value for blood phosphorus varied from normal to as low as 0.8 mg. during this interval.

Post-mortem examination was performed September 1, 1932. Exploration of the operative site revealed a very small amount of thyroid tissue, which, microscopically, gave marked evidence of degeneration, almost

FIG. 8. Case 11. Cut surface of upper end of left femur obtained at necropsy.

suggestive of myxedematous changes. A small portion of the thyroid gland had been removed from the right side. The left lobe of the gland was intact. Three parathyroid bodies were found, two on the left and one on the right side. These were all slightly larger than normal and, histologically, appeared to be hypertrophied. Microscopically, there was no reason to believe that the function of the remaining parathyroid bodies was in any way impaired. All of the bones gave evidence of marked decalcification, were extremely soft, and were easily cut with a knife (Figs. 7 and 8). There was little histologic evidence of either resorption or of deposition which suggested arrested metabolism, perhaps due to exhaustion. The liver had undergone atrophy, and gave evidence of fatty change (graded 3) and icterus (graded 1). There were also some fatty changes in the kidneys and melanosis coli (graded 4). Approximately 300 c.c. of ascitic fluid were present.

COMMENT

Although no one has had extensive experience in surgery of the parathyroid bodies, certain general principles and factors of safety have become evident. Wide exposure of the region may be obtained through the ordinary approach to the thyroid gland. Realizing that these tumors are frequently bilateral, it is important to examine both sides before starting local resection on either side. If this precaution is neglected one may remove a small adenoma on one side, only to find a much larger one on the other side, removal of which might leave an inadequate supply of functioning parathyroid tissue.

Localization and recognition of parathyroid tumors may afford considerable difficulty. If the presence of a tumor is strongly suspected, despite lack of any recognizable enlargement in the usual situation of these adenomas on the posterior surface of the thyroid gland, further search should be conducted behind the trachea, in the upper mediastinum, laterally in the neck and anterior to the thyroid gland. We strongly suspect that in some of the cases of typical generalized osteitis fibrosa cystica associated with disturbed calcium metabolism, when tumors have not been found, but parathyroid bodies, normal in size and cytologic characteristics have been removed with subsequent improvement, an undiscovered adenoma aberrantly situated remains undetected. At times a parathyroid adenoma may be imbedded within the thyroid gland and resemble, even on close inspection, an ordinary thyroid adenoma. The yellowish-brown or bluish color of a true parathyroid tumor usually suffices to render its identification certain; however, preparation of frozen sections before the wound is closed is extremely desirable in questionable cases.

The main danger in removing these tumors arises from their customary situation close to the recurrent laryngeal nerve. Adequate exposure and the hemostasis secured by ligation of the inferior thyroid artery before removal of the tumor aid in accurate and careful dissection. Local anesthesia, supplemented

if necessary with a little gas, affords sufficient analgesia and permits early recognition of trauma to the nerve. After operation, one should always be prepared to administer parathormone and calcium if necessary to avert tetany, for this is not an uncommon temporary development following removal of a tumor, apparently indicating an evanescent disturbance of parathyroid function during the period of readjustment after resection.

At the present time there seems to be insufficient evidence to warrant broadening the scope of surgery of the parathyroid glands to include such diversified maladies as osteomalacia, Paget's disease, rickets, chronic deforming arthritis, and generalized myasthenia. Experimental investigation has failed to elicit any data, to our knowledge, which definitely suggest a direct etiologic relationship of these ailments to dysfunction or hyperfunction of the parathyroid bodies. On the other hand, the typical clinical picture presented by the cases just cited has been repeatedly reproduced by prolonged administration of parathormone to the experimental animal. The general hygienic and dietary measures employed in the treatment of Paget's disease, osteomalacia, and so forth, may be responsible for the improvement attributed by some authors to subtotal removal of the parathyroid glands although the glands have been often reported normal to gross and microscopic inspection in these cases. We have seen similar temporary response in typical cases of hyperparathyroidism under medical treatment. Remissions are not uncommon; at least, to date no cases have been followed for a sufficient length of time to allow definite conclusions to be drawn regarding the efficacy of operations on the parathyroid glands in the absence of the characteristic chemical and skeletal changes indicative of the typical syndrome of hyperparathyroidism. Hunter, in England, who has had considerable experience with parathyroidism, is likewise of the opinion that cases of focal osteitis and osteomalacia are unrelated to generalized osteitis fibrosa cystica. The low level of blood calcium typically observed in osteomalacia, and also the frequency of

spontaneous tetany are the antithesis of what is seen in hyperparathyroidism. Experimental clinical surgery of this type is not to be deprecated, however, when conducted by a scientific group of capable investigators, and it is to be hoped that the truth will soon be elicited.

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DISCUSSION

Dr. Harvey B. Stone, Baltimore, Md.: It seems to me that possibly we are going through the early stages of this endocrine question, similar to those we went through in the development of thyroid surgery. You all recall that Kocher and the other early thyroid surgeons at first took out the entire thyroid gland, but learned from experience that they produced the condition of myxedema. I wonder whether it is not possible that further experience with cases like Dr. Rankin's second case may not lead us to attempt a partial resection of these tumors of the parathyroid structures, with the same idea with which we treat toxic goiters at present. I wonder whether, although the parathyroid is diseased, and although it requires surgical eradication, it will be learned by experience that total removal, in some cases at least, is not the course of wisdom, and leaving a portion of the mass behind may not prove to be the wisest course. I would like to know Dr. Rankin's viewpoint upon this matter.

Dr. Earle Drennen, Birmingham, Ala.: Dr. Rankin's cases appeal to me because I recently saw a case which was quite similar to one of the two presented by him. The case seen by me was that of a pet monkey which had recently died. An autopsy was held by Dr. George Graham, our pathologist, and he found a universal cystic condition of the long bones with a concomitant enlargement of one parathyroid gland. The enlarged parathyroid gland in this case was larger than the accompanying half of the thyroid gland. We have not had time to study the case microscopically, but we hope to report upon it later.

Recently Dr. A. J. Walton* reported 4 cases of tumor of the parathyroid, and in one case the gland was found in the posterior mediastinum. This case required two operations because the gland was not found at the first operation.

Dr. Willis C. Campbell, Memphis, Tenn.: I wish to ask if bone lesions, other than diffuse or progressive osteitis fibrosa, were observed in the cases operated upon, and also if excision of parenchymatous tissue from normal parathyroid glands had been carried out with the object of arresting a progressive osseous lesion, and if so what has been the result? It has been apparently definitely proved that progressive osteitis fibrosa cystica is closely related to hyperparathyroidism, and excision of adenomas and areas of hypertrophied gland tissue induced definite relief of symptoms, and in early cases cure. Improvement or arrest of other osseous lesions, as osteitis deformans (Paget's disease), bone cysts, and multiple giant cell tumors have been reported but there still remains considerable doubt as to the rationale in lesions other than diffuse osteitis fibrosa cystica.

* *Brit. S. J.*

DR. FRED W. RANKIN (*Closing*) Replying to Dr. Campbell, I think we have paralleled his experience in trying to be very conservative in determining which group these changes are found in. In the types he mentioned we have not had any experience. There are reports of cases where so-called hyperplastic thyroids have been removed with quite satisfactory end results, but we have not seen any of these cases.

Regarding the probable advisability of a partial resection of a thyroid adenoma, I think that point is particularly well taken. In our last case at necropsy three parathyroid bodies were found by the pathologist. In spite of the fact that the patient had three parathyroids remaining she certainly had an imbalance in the metabolism and I might have done better by removing only a piece of the tumor. I know of a case in which the operating surgeon operated and located the adenoma of the parathyroid in the mediastinum after resecting a portion of the manubrium, and I think he very wisely did not remove all but took out only a section. I do not know about the partial resection of parathyroids for I have not had any experience with that procedure.

PERIPHERAL NERVE SYMPTOMS IN GOITER

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PSYCHIC disorders are prominent in the symptomatology of hyperthyroidism. Varying from emotional instability to delirium or mania, they occupy a conspicuous place in the clinical picture. Disturbances of the vegetative nervous system ramify throughout the constitutional as well as the local manifestations of goiter with or without hyperthyroidism. The cranial and spinal peripheral nerves are much less often involved in the local or remote pathological processes associated with goiter.

Damage to the recurrent laryngeal nerve is the most common of these local peripheral nerve changes. The nerve may be infiltrated by inflammatory products, by extension of a malignant tumor, pressed upon by a large goiter, stretched over the goiter, or over the trachea when this organ is dislocated by an asymmetrical enlargement of the thyroid. In the last event the vocal cord on the side opposite to the thyroid swelling is likely to be paralyzed.

Matthews[1] notes that small hard lobes are more likely to injure the laryngeal nerves than larger soft ones.

Examination of the vocal cords before operation is a wise precaution and may prevent unpleasant sequelae.

The nerves supplying the orbit and its region are frequently involved in association with goiter. The toxins of hyperthyroidism are believed to be the cause of the pathological changes which have been observed in the nuclei of these nerves.

Naffziger[2] reports a case of ophthalmoplegia and optic atrophy with progressive exophthalmus following thyroidectomy for toxic goiter with exophthalmus, in which there was great increase of the intraorbital tension. The patient showed rapid and permanent improvement after decompression of

the orbital contents. The increased intraorbital tension was caused by increased volume of the extra-ocular muscles due to muscle swelling from edema with fibrosis. These changes are similar to those noted by Brooks[3] occurring as a result of marked obstruction to the venous return from muscles of the extremity.

Naffziger's last report[4] was based on the results obtained in six patients. Ten orbits were studied and treated.

Pressure within the orbit therefore must be considered in determining the cause of some of the ocular paralyses associated with exophthalmic goiter.

In many of the reported cases changes in the third, fourth and sixth nerves were associated with disturbances of the cervical sympathetic, either irritative or paralytic, sometimes transitory or intermittent. Marked variability of symptoms results from such combinations.

Heuer[5] studied the cerebral nerve disturbances in exophthalmic goiter and reported a case in which there was a bulbar palsy. He calls attention to the serious nature of this complication. All the reported cases have had a fatal termination.

Paralysis of any of the cranial nerves may occur. In most of the reported cases a group of nerves has been involved although palsy of a single nerve, especially of the sixth, has been observed. According to Heuer, the spinal accessory appears to be the only cranial nerve to have escaped involvement in exophthalmic goiter.

Spinal nerve palsies associated with goiter are rarely reported.

Rachford[6] reports a case in which the right phrenic nerve was paralyzed by pressure of a large goiter, with symptoms of hyperthyroidism. The patient was treated by means of the *x*-ray, but the diaphragm remained paralyzed one year after treatment was discontinued.

D'Abundo[7] reports a special bulbospinal syndrome due to dystrophy of the thyroid. An abstract of his paper gives the

impression that myasthenia gravis may have been responsible for some of the symptoms.

Burger[8] interprets the muscular weakness of the lower extremities and the atrophy of the small muscles of the hand, with dysphagia and indistinct speech, as symptoms of some sort of inflammation in the gray matter of the anterior horn of the cord and in the bulbar cells. In addition to the symptoms mentioned the patient showed definite signs of Basedow's disease, with a firm small goiter.

Sezary and Bartel[9] report a case in which the brachial plexus and the subclavian vessels were compressed by a large simple goiter. There was atrophy of the entire arm with some sensory disturbance.

The following is a report of a case of nodular goiter with hyperthyroidism in which there were symptoms suggesting pressure on part of the brachial plexus.

The patient, a middle-aged white man, was admitted to Mercy Hospital under the care of Dr. M. C. Pincoffs, who made the diagnosis and referred him to me for operation. The symptoms of hyperthyroidism were not definite. There was some general loss of strength, coarse and fine tremor of the hands, quick speech and movements. The facial expression was a little drawn. The pulse rate varied from 90 to 120, the basal metabolic rate on three occasions was 39, 42 and 44.

The thyroid was deep set, the isthmus thick and firm. There was a hard almond-sized nodule in the right lobe. The left lobe was firm and situated deep in the neck.

The patient complained of severe pain in the left arm and forearm in an area roughly that of the distribution of the internal cutaneous nerve. At operation the firm nodular thyroid was found tightly wedged in under the muscles. The left lobe extended outward and backward a considerable distance into the neck. The isthmus and the greater part of both lobes were removed. The patient made a good recovery. Immediately after the operation the pain in the left arm disappeared and four months later had not recurred.

Apparently this pain was caused by pressure of the left lobe of the thyroid on the brachial plexus, which was relieved by the removal of the goiter, but disturbance of the cervical sympathetic may be a factor.

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DISCUSSION

Dr. E. Dunbar Newell, Chattanooga, Tenn.: About twelve years ago I had a case that was similar to Dr. McGlannan's. A doctor had constant, intense pain in the right shoulder. The thyroid was quite hard and although there was no definite hypertrophy the trouble was sufficient to make him think it was due to the thyroid. He consulted Dr. Crile, who did not advise operation for he did not think the pain in the shoulder was due to the thyroid. The patient consulted me. I told him it was unusual to have such pain from the thyroid but he insisted on an operation for he had never had the pain until he noticed the beginning of the enlargement. I removed the gland and the pain, which had been so severe that he had to take morphine, was immediately relieved. He has never had the least pain since that time.

CONGENITAL STENOSIS OF THE CARDIA

WITH REPORT OF A CASE IN A TWO-DAY-OLD INFANT

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JUDGING from the published reports upon the subject, cardiac obstruction in the infant is either rare, or else cases of vomiting from this cause are being explained on simpler grounds, and this condition is being overlooked. At any rate there are few reported cases in the literature. Messeloff of New York and Shulman of Boston, in a joint paper published in 1928, reported a case in a child ten and one-half years of age, and reviewed the literature from 1879 up to that time. They found only 11 reported cases in children under twelve years of age. The youngest was two months of age, reported by Beck, a German surgeon, which case had no *x*-ray study. This patient was cured by introduction of a catheter from above and feeding through the catheter. The patient whose case Messeloff and Shulman reported, died following an esophagoscopic examination.

The cause of this condition has been speculated upon and theorized about at length. Some of the more common explanations are: congenitally defective vegetative nervous system, giving rise to a poorly balanced neuromuscular swallowing reaction, vagotonia or sympatheticotonia; pinching of the esophagus as it passes through the diaphragm; mechanical kinks from pressure, adhesions, or deviation of the normal course of the esophagus, and lastly psychoneurosis.

The morbid anatomy has been described as pure spasm in the region of the cardia; as actual narrowing of the submucosal fibrous tissue: and as normal tone at the cardia coupled with a lack of tone in the esophagus above. In all likelihood all three elements enter into each case in varying proportions.

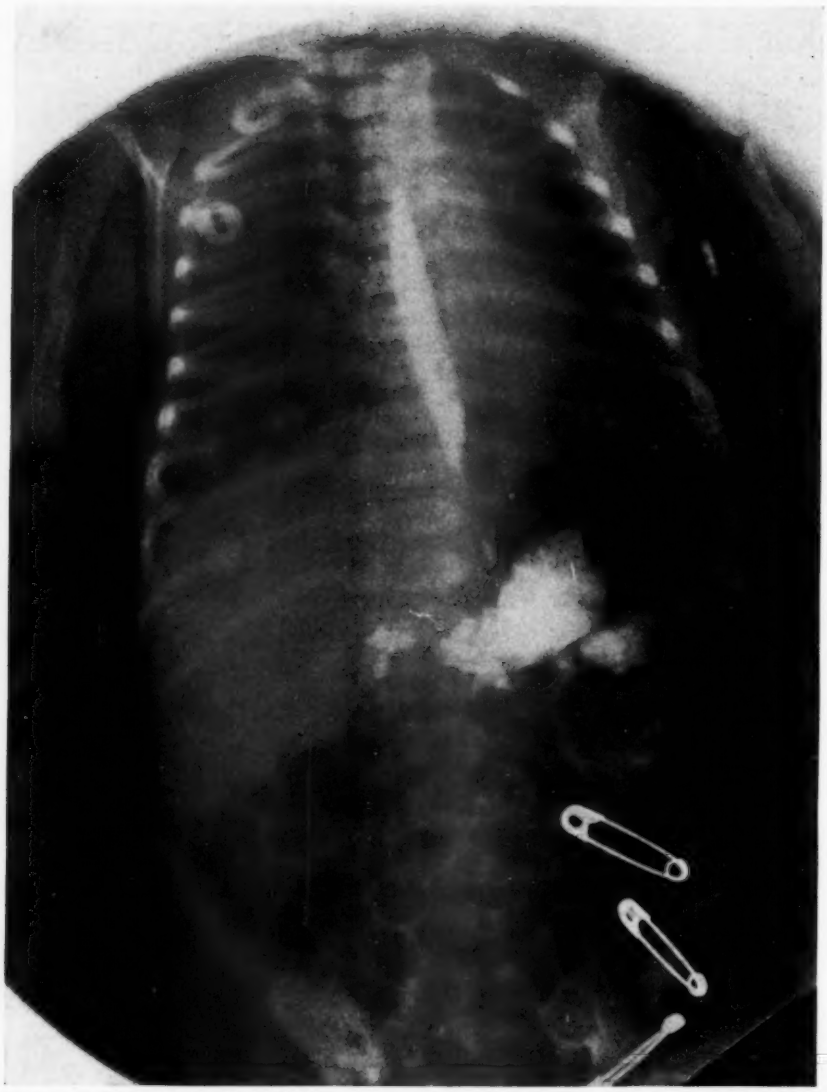

FIG. 1. X-ray film taken when baby was two days old, showing slight amount of barium in stomach, and typical spindle-shaped esophagus, closed at cardia and dilated above. This film was taken one hour after administration of barium, and after administration of atropine to physiological limit.

At any rate the *x*-ray findings universally show a definite constriction at or just above the cardia, and a definite dilatation of the esophagus above this area.

FIG. 2. Braasch cystoscope introduced through gastrostomy opening, and cardiac orifice catheterized with a No. 6 Fr. ureteral catheter. Thread is being threaded through end of catheter, to be withdrawn through gastrostomy opening.

T. L. Birnberg[1] in a comprehensive paper on this subject reported the cases of three infants with slight spasm and

[1] Birnberg, T. L. Cardiospasm in new-born infant. *Am. J. Dis. Child.*, 38: 1183, 1929.

delay of barium in the esophagus. He stated that recognition of the condition in a newborn infant had not been recorded.

It was our good fortune to have had under our care at the

FIG. 3. Continuous string to which has been tied a soft rubber dilator, which has been pulled through gastrostomy opening into cardia.

time this paper was written, a newborn infant with this condition, recognized when the baby was two days old. It is for the

purpose of placing this case on record, and for discussing some of the problems arising in its care, that I wish to bring the case to your attention.

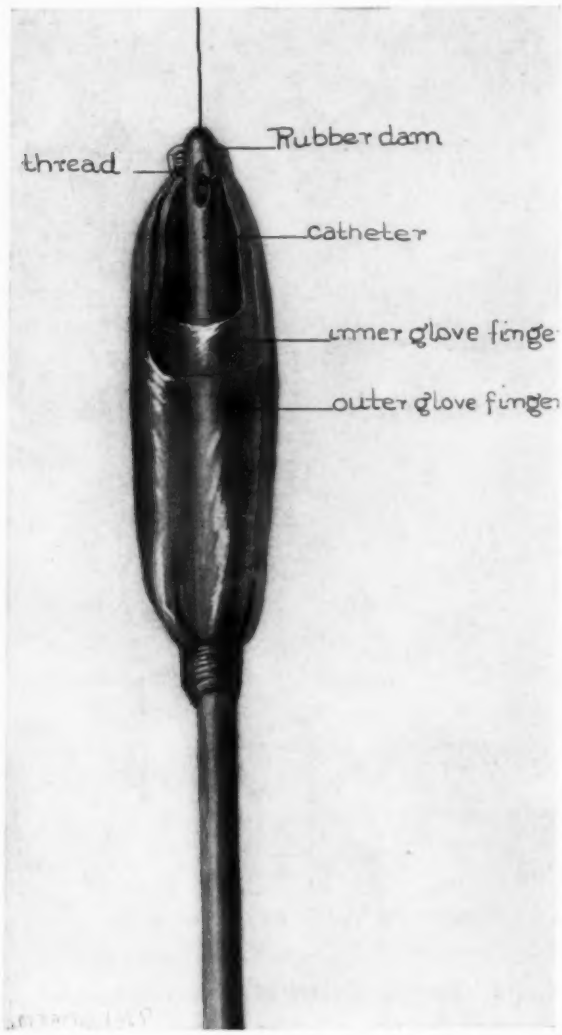

FIG. 4. Construction of small hydrostatic dilator, made after plan of a Plummer dilator.

Baby Y., male, the second child of healthy parents, normal delivery, was born in St. Vincent's Hospital, February 17, 1928. Our pediatrician, Dr. T. E. Buckman, was called to take charge of the feeding problems which might arise, and they proceeded to arise as soon as the baby began to take anything into the stomach. As nearly as one could judge, there was never from birth any food or water which reached the stomach. Feedings

would be swallowed and after a few moments would be vomited just as taken, and in the same quantity. The vomiting was rather forceful at times. The general physical examination of the child was negative.

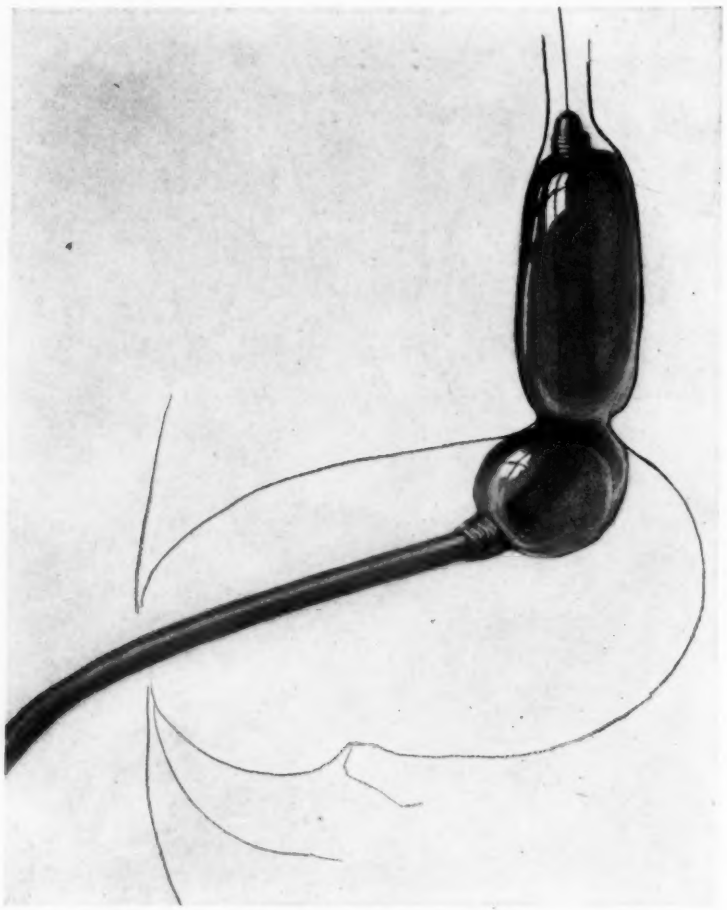

FIG. 5. Diagrammatic illustration of use of hydrostatic dilator.

When the child was two days old an *x*-ray examination of the chest was made in a search for a persistent thymus gland or some other cause for the apparent obstruction of the esophagus. The first films showed nothing except a shadow near the hilus of the left lung which was thought to be an enlarged mediastinal gland. The baby was then given a barium mixture with a medicine dropper and a slight amount trickled through into the stomach, but the majority of it remained in the esophagus, churning about for an hour, in spite of the administration of atropine to the physiological limit. Finally the barium was vomited. Efforts were then made to

pass catheters and bougies into the stomach through the esophagus, but this could not be accomplished. An impassable obstruction at the cardia was met with, which would not give way with as much force as was thought

FIG. 6. Photograph of patient at two years of age.

wise to exert. Efforts to get the baby to swallow a thread to be used as a guide to dilatation were also unsuccessful. A re-check with barium was made the next day and the same condition found to exist. The baby was becoming somewhat dehydrated, and nothing was passing the cardia, so something had to be done. Two courses were discussed, one was an effort to get by the obstruction with an esophagoscope, and the other to do a gastrostomy and later plan the dilatation of the cardia. The latter

course was chosen as being the least dangerous to the life of the child, so on the third day of the child's life, a gastrostomy was done.

Under local anesthesia a No. 16 catheter was introduced into the stomach and fixed in position. An exploration of the cardiac end of the stomach and of the diaphragmatic opening at the time of the gastrostomy showed nothing of note except some crescentic bands extending from the fundus of the stomach up to the under surface of the diaphragm, in the region of the cardia. Whether these were a part of the normal reflection of peritoneum or not, I am unable to say.

Feeding through the tube was begun immediately, and the baby began to improve and to gain weight normally. At the end of ten days the tube was removed, a Braasch cystoscope passed into the stomach, and by locating the lesser curvature and following it up to the region of the cardia, we located it easily. It appeared as a small dimple, about the size of a small ureteral meatus. A No. 6 ureteral catheter was passed through it without difficulty. As it reached the posterior wall of the pharynx the baby gagged and the end was easily picked up with a hemostat and drawn out through the mouth. A silk fishing line was threaded through the end of the catheter with a needle and the catheter withdrawn. The ends of the thread were tied together, thus making a through-and-through continuous thread, to which could be attached dilators, or over which could be threaded bougies. The tube was then replaced for feeding, the string coming out of the opening alongside of the tube.

The next day dilatation of the cardia was begun. This was done with a graduated set of Jackson dilators, made of flexible rubber, with a string through the center with a loop on each end. The dilators were tied to the end of the continuous thread and pulled through the gastrostomy opening and on through the cardia until size No. 24 was reached. They were then tied on above and introduced through the mouth and pulled through the cardia from below. Finally we made a hydrostatic dilator of small size by the use of glove fingers placed over the end of a rubber catheter, as shown in the diagram. We used this, gauging the amount of dilatation by introducing a measured quantity of water into the catheter with a syringe. Dilatation seemed to be somewhat difficult until we reached a size 24 dilator, after which time dilatation was easy. No manipulations were accompanied by shock or other untoward reactions, and none seemed to give the baby much discomfort.

Within three weeks the baby was taking a formula by mouth normally, and a re-check of the cardia showed no delay at this point. The gastrostomy tube was left in place for three weeks more, to be sure there was no return of the cardiac contraction, and was then removed. The gastrostomy wound was slow in closing, so three weeks later, under local anesthesia, the

stomach was freed from the abdominal wall, the opening closed, and the stomach dropped back into the abdomen. The wound was closed, healing taking place without incident.

The baby since then has followed the usual feeding and growth of a normal child, and is now a big husky lad, nearly five years old. There have been absolutely no symptoms of any kind referable to the gastrointestinal tract, since the case was finally dismissed.

A narration of the sequence of events in this case at this time, makes everything look simple, but that is the usual simplicity of hind sight. Confronting the various problems as they arose at the time, and trying to solve them without any precedent to guide us, was not so simple as it now seems.

I trust that a recording of our experiences with this case may be the means of simplifying the same problems for someone else, who may have a similar experience.

DIVERTICULOSIS OF THE DUODENUM

WITH REPORT OF CASE IN FOURTH PORTION OF DUODENUM

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THE duodenum has the general shape of a horseshoe. It surrounds the head of the pancreas and is so placed that its concavity faces upward and to the left while its convexity falls downward and to the right.

For purposes of description the duodenum is divided into the superior, descending and inferior portions. The terminal part of the inferior portion which bends slightly upward and to the left forms the ascending or, as some authors term it, the fourth portion of the duodenum. This portion passes upward over the third and is situated at the left side of the body of the second lumbar vertebra.

The situation of the duodenopyloric junction corresponds to the disc between the last thoracic and first lumbar vertebra. The distance therefore, between the two ends of the duodenum is but slightly more than the width of the second lumbar vertebra. Just proximal to this fourth portion of the duodenum, the superior mesenteric vessels cross the bowel, while the aorta and vena cava lie just behind it.

Diverticulosis of the duodenum may occur in any portion of the bowel, but is most frequent in the superior portion.

In a series of necropsies at the Mayo Clinic[1] in which the duodenums were examined for diverticulosis, it was found to occur in 2.2 per cent of the series; 14 had single pockets and 6 had two pockets. They were all located within a range of 3 cm. of the ampulla of Vater; only 4 were below it and the remainder to either side or just above the opening of the common duct. All were closely associated with the pancreas, many being buried in its substance. All were classed as

developmental diverticula and none of them had given rise to symptoms.

In the files of the Mayo Clinic up to 1924 were found 19 acquired diverticula in which all the coats of the bowel were represented. These were verified at operation. They were all situated in the first portion of the duodenum in the antero-inferior portion. In this series a diverticulum was diagnosed by *x*-ray in 5 patients, while in 11 only an associated lesion was diagnosed, and in one an *x*-ray was not made.

In 1913, Case[2] was the first to publish an instance of diverticulosis diagnosed during life by means of the *x*-ray and the opaque meal.

In 1915, Forssell and Key[2] diagnosed a case by *x*-ray and removed it by operation.

In an interesting article by Odgers[2] of the University of Oxford, the whole subject of duodenal diverticulosis is reviewed. He stated that during the past fifteen months he had found two instances of duodenal diverticulosis in the dissecting rooms. In the first instance a woman sixty-three years old had five diverticula, all in the second, third, and fourth parts. The second instance was a man seventy-one years old, with two diverticula along the upper border of the termination of the transverse and the commencement of the ascending portion of the bowel. In this article he gives the following data: up to 1908, less than 100 cases of duodenal diverticulosis had been recorded, and these were regarded as anatomical curiosities. He observed that in autopsies diverticula of the duodenum are found in from 3 to 16 per cent of cases, and in *x*-ray examinations in from 1.5 to 5 per cent. They were located in the fourth portion in 2 per cent of the cases diagnosed by both autopsy and *x*-ray up to the time of the publication of Odger's article in 1930. Up to this time 23 cases of duodenal diverticulosis had been operated on. In all operated and recorded cases, the diverticula have occurred four times in the fourth portion of the duodenum.

In the literature to which I have had access, I have found only one case of diverticulosis of the fourth portion of the duodenum treated by operation, and in this case[9] a resection of the duodenum with a side-to-side anastomosis was successfully done.

There are some interesting things in the literature about these diverticula, one being that when they invert themselves, or when they are inverted purposely, which is the easiest way to dispose of them, they sometimes continue to enlarge and fill up with a gelatinous sort of material, and eventually may produce either acute or chronic intestinal obstruction. They should, therefore, always be resected when inversion is practiced. Finney[5] explains that the intestinal obstruction may be brought about by the formation of fibrous tissue in the bowel, through the influence of repeated infection extending from the diverticula into the wall of the intestine; the bowel wall becomes infiltrated, thickened, distorted, and ceases to function.

Authorities are not agreed as to the frequency of duodenal diverticulosis. Some refer to its rather frequent occurrence, and others to its rather infrequent occurrence.

Babcock[3] makes the observation that diverticulosis of the duodenum is found in about 20 per cent of all cadavers, and in about 1.2 per cent of all patients *x*-rayed. He also observes that they may occur: (1) on the anterior peritoneal surface; or (2) may be embedded in the pancreas; (3) or behind the pancreas in the retroperitoneal space.

The most frequent site is about the ampulla of Vater, and in this situation they may bear all sorts of relationships to the pancreas, and may obstruct the common duct or the duodenum. It is also thought that diverticula in this site may be caused by traction by the common duct, or be produced by a weak spot, marking the entrance of the common duct into the duodenum, or by weak spots produced by the veins leaving the intestine and entering the mesentery.

One author points out the frequent occurrence of pancreatic tissue in the walls of the duodenal diverticula, and thinks this

speaks in favor of their origin in supernumerary anlages of the pancreas. He states that the duodenum is the portion of the intestine that changes most during fetal development and is thus predisposed to disturbances of development; and he thinks, therefore, that the duodenal diverticula are acquired pulsion diverticula on the basis of a congenital anatomical predisposition.

Some writers think they are acquired on the basis of other congenital defects such as defective areas in the circular muscle, or along the sheath of veins, and it has been observed that engorgement of mesenteric veins as in liver, heart, or kidney disease, may weaken the walls of the duodenum where the veins emerge, and thus afford "weak spots" for beginning diverticula. This theory is easy to apply along the mesenteric border.

Finney[5] states that of recent years there has been a fairly large number of duodenal diverticula recorded in the literature. These were found usually in the second portion of the duodenum, and suggest a pouching of the duodenal wall rather than a true diverticulum. They are often associated with pyloric or duodenal ulcer.

Lewis[4] says that diverticula are of infrequent occurrence in the duodenum, and that the first cases were found at postmortem. He thinks they should be classed as: (1) congenital, or true, in which the sac is composed of all the layers of intestinal wall, and (2) the acquired or false, in which the muscular coat is lacking. Both types may be caused by traction from without, or pressure from within.

Some authorities believe that all diverticula are acquired because they occur most frequently from fifty to fifty-six years of age, but can occur at any age. They occur most frequently in the male.

In size they vary from 0.5 to 5 cm. in diameter, and may have either a wide neck or a very narrow one. They may contain intestinal juices, food particles or concretions. They

are often associated with gallstones and peptic ulcer. They may or may not be inflamed. They may be multiple.

Lewis states that the symptomatology is not definite, and that they are usually incidental findings in the *x*-ray examinations. The symptoms usually lead one to suspect biliary disease, peptic ulcer, acute or chronic ileus, malignancy or intestinal toxemia.

Several observers have noted that the symptoms, when due to diverticulosis *per se*, disappeared during the night but increased during the day; and that they were somewhat improved by changing the position of the body to one that might, perhaps, promote emptying of the diverticulum.

In my case, in addition to the attacks of epigastric pain and gas, the most notable symptom was the relief afforded by gentle massage of the upper abdomen.

Lewis reports 3 cases operated on by himself. One was in the second portion, and two in the first portion of the duodenum. One was amputated and dealt with as an appendix; one required posterior gastroenterostomy, and one was treated by inversion. Two of them were traction diverticula and were associated with dense adhesions. One was associated with the scar of a healed duodenal ulcer but the scar seemed to bear no etiological relation to the diverticulum.

The dangers of diverticulosis are contingent upon diverticulitis, which usually results from retention and may lead to hemorrhage, perforation, gangrene, abscess, and penetration into other organs, or malignancy.

The treatment is conservative including rest in bed, gentle massage, dietetics, and such general medical care as may be indicated; or surgical, including resection and suture; resection with inversion of the stump; or inversion with or without resection; resection and suture with or without gastroenterostomy; gastroenterostomy with or without occlusion of the pylorus; lastly, resection of the bowel. Any one, or a combination of these operations may be required in a given case. All large diverticula should be operated on.

REPORT OF CASE

The case I have to report is that of a woman fifty-eight years of age, married, white, and a housewife. About one year ago she rather suddenly

FIG. 1. "Barium-ball clue" left behind after stomach and duodenum are thoroughly evacuated.

began having stomach trouble, consisting of pain in the epigastrium, and gas. These attacks would come on without reference to time of taking food, or to the quantity or quality of food taken. They were occasionally accompanied by nausea and vomiting.

These attacks steadily increased in severity and frequency, and finally she noticed that massage of her upper abdomen gave considerable relief during an attack. Her chief complaint on admission was pain in the epigastrium, gas, loss of appetite, and loss of weight and strength.

She had had the usual diseases of childhood, and was the mother of nine children, all living and well. She had been treated ten years previously for kidney trouble and anemia and had fully recovered.

FIG. 2. Patient in prone position. Stomach with normal rugae and with duodenal cap and diverticulum filled.

On examination she was emaciated, sallow, and cachectic, presenting the general impression of terminal malignancy. Temperature 98.6°F., pulse 84, B.P. 140/90. The head, neck, and chest were negative.

The abdomen was negative except for marked tenderness on pressure over the epigastrium. Palpation over the gall bladder, liver, spleen and appendix did not reveal evidence of disease. The extremities were negative, except that tendon reflexes were apparently exaggerated. Heart and lungs were negative. Urinalysis, negative. Blood count: Hemoglobin 81 per cent, red cells, 3,980,000, white cells 5500, polymorphonuclears 69 per cent. Blood Wassermann reaction, negative.

X-ray (Dr. McDeed): Gastrointestinal series revealed a diverticulum about junction of duodenum and jejunum, about 2 inches in diameter and about 3 inches long, with a narrow neck. After the duodenal diverticulum

FIG. 3. Patient in right ventral oblique position. Diverticulum completely filled with barium, also diverticulum is not connected with stomach.

was suspected, a second and third series were made for confirmation.

The *x*-ray examination is of chief importance, but as the findings are usually more or less incidental, all clues must be carefully noted and followed out. Here, for instance, a great many pictures were made with practically negative results, but, after one *x*-ray series was completed it was noticed that a round ball of barium remained high up in the abdomen by the left side of the second lumbar vertebra; with this as a lead and with other *x*-ray series, we obtained the definite data as shown in Figures 1–4.

The *x*-ray data of use in diagnosing this condition have been contributed by several observers. Forssell and Key[6] noted the presence of an apparently, or entirely round contrast shadow in the course, or in the direct neighbor-

hood of the duodenum. They noted its persistence after complete evacuation of the stomach and duodenum and its displaceability with regard to the abdominal wall, and its peristalsis. Jacquelin and Quenu[7] observed

FIG. 4. Patient standing. Diverticulum by left side of second lumbar vertebra. Gas is now replacing barium in diverticulum, filling its upper portion while barium is draining back into bowel.

that the barium in the diverticulum becomes surmounted with air with the patient in the standing position.

Albrecht[8] noted the barium passing over, or beside, this rounded shadow into the aboral duodenum.

This case presented practically all of these *x*-ray data.

Operation was performed on October 26, 1931. The abdomen was opened through a 6-inch incision along the inner border of the right rectus muscle, beginning at the right of the xyphoid cartilage.

The stomach, duodenum, liver, gall bladder and ducts were explored from above with negative results except for a few spiderweb adhesions between the gall bladder and duodenum. The transverse colon and omentum were then brought well out of the abdomen. The transverse mesocolon was opened through an avascular space, just above the root of the mesen-

tery. The diverticulum was easily found, and it was large and filled. It was covered over with a flimsy layer of areolar tissue, derived probably from the peritoneum. This was stripped off leaving the diverticulum standing out covered over with a lacework of white, fibrous cords, representing the muscular structures of the intestine. The sac was probably a little more than 2 inches in diameter, by about 3 inches long, and its neck was about ¾ inch across, and occupied the terminal ascending portion of the duodenum, coming off about the junction of its free and attached borders.

After the sac was isolated two artery forceps were placed across the freed neck and the sac excised between the forceps. The stump was sterilized with a little iodine and sutured by the Kerr method, reinforced with a Lembert suture. The transverse mesocolon was repaired, and the appendix, which was thick and fibrous, was removed.

The sac contained only the usual intestinal juices and could empty easily.

The pathologist, Dr. Braden, found it to consist of all the layers of the intestinal wall, it was not inflamed, and showed no evidence of malignancy.

The abdomen was closed without drainage. The patient made a good recovery, has been relieved of all abdominal complaints, and has improved greatly in a general way.

An unusual finding was an artery almost as large as the radial, which arose apparently from the superior mesenteric and passed directly to the left, crossing the duodenum just about the duodeno-jejunal junction. This vessel crossed the duodenum a little distal to the location of the neck of the sac. We have, then, a short segment of duodenum converted into a sort of trap, the proximal end of which lay between the aorta behind and the superior mesenteric artery in front, the distal end being crossed by this anomalous or aberrant vessel of considerable size. Also, this segment of duodenum presents a marked curve near its distal end. One may well imagine that it would be more difficult for such a segment to empty itself than for a segment of similar histological make-up, but straight and unobstructed. This leads to the belief that this diverticulum is the result of increased pressure within this particular duodenal segment, especially since it was located at or near the point where greatest pressure would occur, i.e., at the apex of the curve, and further, that the increased pressure is due to the anatomical arrangement described.

CONCLUSIONS

1. In all gastrointestinal cases in which *x*-rays for peptic ulcer or biliary tract disease show negative results, duodenal diverticulosis should be considered.

2. The "ball of barium" remaining in the upper abdomen when stomach and duodenum are emptied of barium should

be a clue to be followed by re-raying in different positions to fix the location of the diverticulum with precision.

3. We feel that the "duodenal trap" as described in this paper adds to the causes of diverticulosis in the fourth portion of the duodenum.

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DISCUSSION

Dr. R. P. Sullivan, New York City: Diverticulum of the esophagus, urinary bladder and Meckel's diverticulum have been recognized and dealt with surgically for many years. Duodenal diverticulum as a pathologic entity seems to have escaped serious surgical consideration. Perhaps the reason is because the most accurate index of their frequency is by necropsy reports. *X*-ray findings are reported as the principal mode of recognition. And in these, when the lesion is discovered it seems difficult to determine whether the patient's symptoms are really caused by the diverticulum. The roentgenologist is prone merely to report an anatomical finding. Diagnosticians indicate doubtful admittance that symptoms occur in these cases, unless inflammatory change takes place in the diverticulum. Penetrating ulcer with diverticulum formation or a circumscribed protrusion of the descending portion of duodenum caused by lesions of the pancreas or gall-bladder may be confused with true diverticulum. However, the symptomatology, the location of the diverticulum, and lack of deformity in lumen of the duodenum will aid in differentiation.

Up to 1924, the Mayo Clinic had reported 19 cases discovered at operation or necropsy. Recently Balfour, in a personal communication, stated that in 1931, at the Mayo Clinic, 37 cases were recognized out of 11,009 fluoroscopic examinations of the stomach and duodenum. The European reports seem scant.

The developmental or acquired duodenal diverticula are receptors of duodenal contents and may give rise to a symptomatology demanding surgical intervention. It seems justifiable to report 2 such cases. Both cases were recognized at twelve and sixteen months respectively before operation. Both are now relieved of their original symptoms.

CASE I. Mrs. B., aged fifty-six, complained of a vague epigastric distress occurring after eating at irregular times. The severity of the distress varied in accord with the type of food taken. The onset was insiduous more than five years ago with variable periods of relief. During spells prior to November, 1931, relief was obtainable from lying on the right side. Associated constipation alternating with diarrhea were noteworthy during September, 1931. Medical management was instituted in 1931 with no satisfactory relief. Re-examination in 1932 revealed an increased size of the previously recognized diverticulum in the second portion of the duodenum. Increased retention of bismuth was noted. Some moderate, localized tenderness without resistance, in the region of the duodenum and the head of the pancreas persisted. Otherwise, palpation was not noteworthy. At operation a duodenal diverticulum, made up of all coats of duodenum, about 3.5 cm. long and 1.5 cm. wide was found arising on the inner border of a second portion of duodenum embedded in the pancreas. Two small masses of tissue were attacted to the anterior surface and were later demonstrated to be pancreatic tissue. The contiguous pancreas showed irritation by the localized change in consistency. The opening into the lumen of the duodenum was above the ampulla of Vater and easily admitted the tip of the index finger. The diverticulum was dissected out and excised. The rent in the bowel was closed in longitudinal direction. Oozing from the pancreatic bed was finally controlled and a soft drain inserted. Convalescence was stormy. A hematoma in the bottom of the wound formed, which became infected. A localized pancreatic abscess resulted. She is still draining and indications are that she will get well, unless the infection or necrosis spreads.

CASE II. F. McN., aged sixty-three, was operated by me in 1921 for suppurative and perforated cholecystitis with peritonitis. Convalescence was stormy with considerable vomiting until controlled by continuous gastric lavage with the Levine tube. Since 1925 the patient has complained of vague epigastric distress, more localized than the previous gallbladder distress when pain radiated to the back. Noteworthy since January, 1932, was relief of distress by induced and spontaneous vomiting. He states, "I must continue to vomit until this spot is relieved of the tension." A general medical supervision and dietary control for sixteen months after the recognition of the duodenal diverticulum was made in another city. Our *x*-ray findings were positive, revealing a diverticulum of the second

portion of the duodenum 5 cm. × 3.5 cm. with a very narrow pedicle, extending into the lower part of the second portion of duodenum.

Operation revealed confirmation of the *x*-ray findings. The opening was contiguous to the ampulla of Vater. The wall of the diverticulum was made up of all coats. Because of the location of the opening into the bowel and because of the size of the pouch, a pylorectomy and posterior gastroenterostomy was done, followed by an inversion of the diverticulum. Convalescence was uninterrupted with most gratifying surgical and physiological results.

From these 2 cases it seems justified to indicate that these lesions have more than an anatomical interest and that stagnation when present in the diverticulum is sufficient to warrant surgical consideration. When inflammatory changes are present the management should simulate that of appendicitis.

REMARKS ON

INTESTINAL ANASTOMOSIS

WITH A DESCRIPTION OF A SIMPLE ASEPTIC TECHNIQUE

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THE literature on intestinal anastomosis still consists largely of descriptions of technique, though it is doubtful if a single new principle of operation has been introduced in the last twenty years. Writers seem to assume that the high mortality rate which follows the operation is due to errors in its performance, such as faulty suturing, failure to preserve the blood supply of the bowel, or the inversion of too wide a flange by the stitches. While mistakes of this kind do increase the death rate, there is good reason to believe that they are not the chief cause of it. They have been discussed so long and so often that every surgeon is fully aware of them and of how they can be avoided. It is probable that the high death rate is caused not so much by how the operation is done, as by when it is done. The subject should be considered from a viewpoint higher than that of operative technique. Such a viewpoint is furnished by studies on intestinal obstruction made in recent years. Intestinal anastomosis is done, with few exceptions, for the relief of intestinal obstruction. It should be regarded as one measure among others to be used in the treatment of obstruction. The chief object of this paper is to amplify and enforce this idea. A secondary object is to describe some simple methods of aseptic intestinal anastomosis which have withstood the test of clinical trial.

Intestinal obstruction jeopardizes the success of an intestinal suture (1) because of its systemic effects, and (2) because of its local effect on the bowel.

SYSTEMIC EFFECTS OF INTESTINAL OBSTRUCTION

It is unnecessary to discuss in detail the systemic effects of ileus; their mere enumeration is sufficient. They are dehydra-

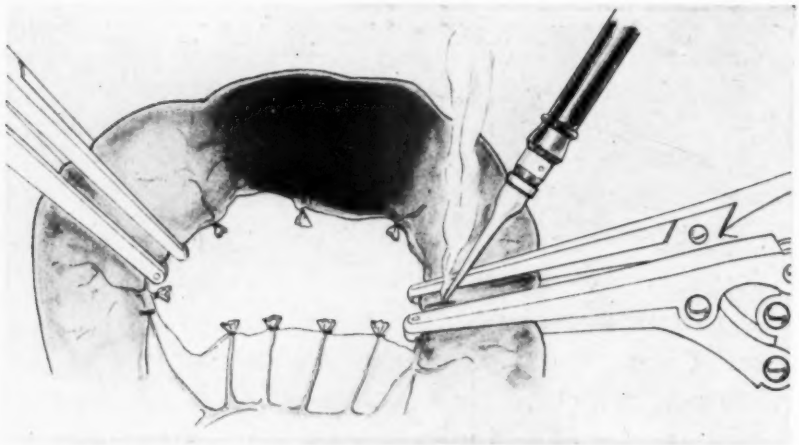


FIG. 1. Resection of segment of bowel for aseptic lateral anastomosis.

tion, acidosis or alkalosis, starvation and toxemia. Any one of these acting alone may cause death, and all of them acting together constitute a tremendous hazard to the life of a patient subjected to resection of the bowel. Bird and MacKay have recently shown that even a moderate degree of dehydration will greatly retard wound healing. Every surgeon has observed that wounds in poorly nourished patients may fail to heal. Toxemia, which most recent writers agree occurs only when strangulation of the bowel is present, completes the list of operative hazards due to the systemic effects of ileus. Fortunately, we are now able to overcome most of these by very simple means. Intestinal resection should never be done before this has been accomplished.

EFFECTS OF INTESTINAL OBSTRUCTION ON THE BOWEL

In 1927, the writer, in association with Dr. H. M. Trusler and Dr. K. D. Ayres, performed experiments to determine the effects of gaseous distention on obstructed bowel. We measured the venous outflow from an isolated closed loop of intestine in

which the pressure could be varied at will. We found that the quantity of blood flowing through the intestinal wall diminished as the intra-intestinal pressure was increased, and that

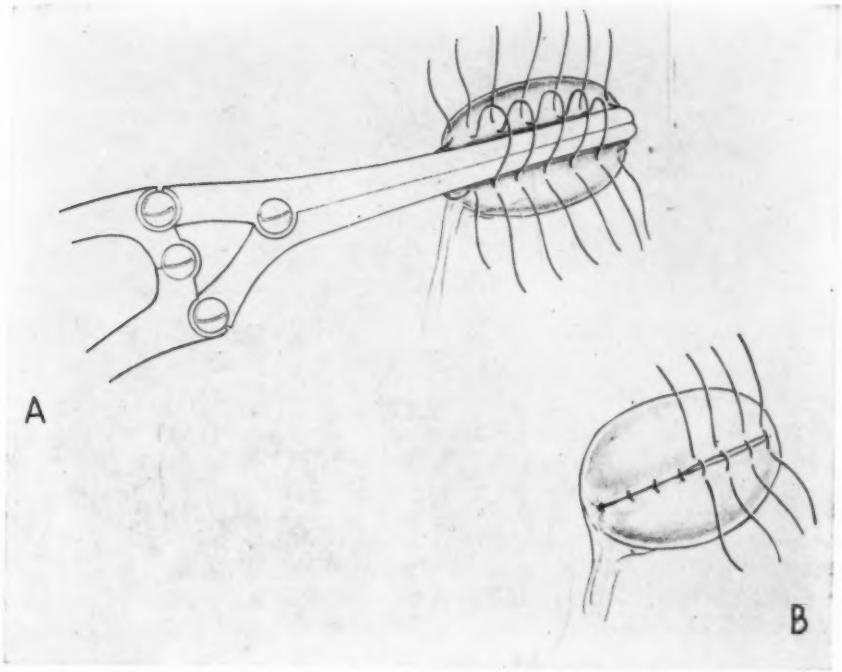


FIG. 2. Closure of bowel ends for aseptic lateral anastomosis. Note that end sutures pass under clamp.

when the intra-intestinal pressure equaled the systolic blood pressure of the animal, the circulation in the bowel wall ceased. We demonstrated that the retarding effect of intra-intestinal pressure on the circulation in the bowel wall is most marked in the antimesenteric portion of the bowel, where gangrene and perforation first occur. These results have been confirmed by Dragstedt, Long and Millet, and by other observers.

The effect of distention on the circulation of the bowel has not been given its due importance by writers on the technique of intestinal anastomosis. Our experiments would seem to demonstrate that the anemia caused by prolonged distention may so devitalize the bowel as to retard or prevent union along the line of suture. Fortunately, distention does not

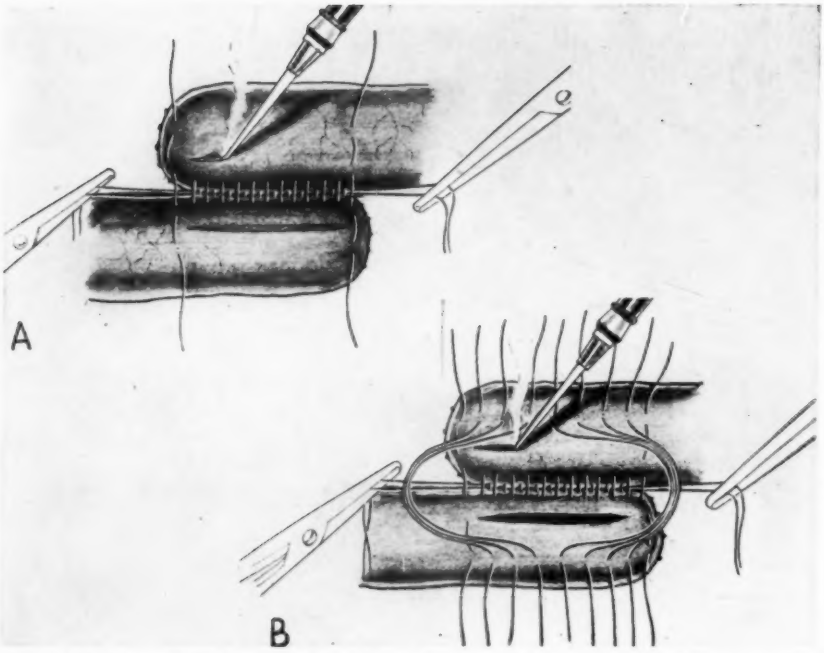


FIG. 3A. Closed bowel ends overlapped for about 2 inches and united by two posterior continuous sutures of silk. First of these is inserted not far from mesenteric border; second just in front of it. It is well at start to place interrupted stitches at each end and in middle of course of first continuous suture, to facilitate its insertion, to insure its uniform distance from mesenteric border, and to prevent making of too long an anastomosis. Ends of first suture should be left long.

When both posterior sutures are in place, course of future incisions in bowel is marked by light strokes of cautery. These serve as guides for insertion of inner row of anterior sutures. Cautery marks should be about 1½ inches in length and should extend to about ⅜ inch of the sutures closing blind ends of bowel. Double Lembert sutures are inserted as shown, beyond tips of cautery marks to close in ends of anastomosis. These are to be tied when anterior stitches, shown in Fig. 3B, are tied.

FIG. 3B. Row of Lembert sutures inserted across cautery marks and pulled aisde to permit burning through bowel along each mark. During this process, entire anastomosis should be held up and steadied by traction on ends of posterior suture left long for this purpose.

When cuts in bowel have been made Lembert sutures are tightened quickly and all together, after which they are tied. Anastomosis is completed by continuous anterior suture of silk which is made to approximate blind ends of bowel to sides of intestine opposite them, so as to cover sutures used to close blind ends. This helps to reduce pockets at each end of anastomosis.

impede the circulation of the colon as much as it does that of the small bowel.

Another effect of distention is to produce partial or com-

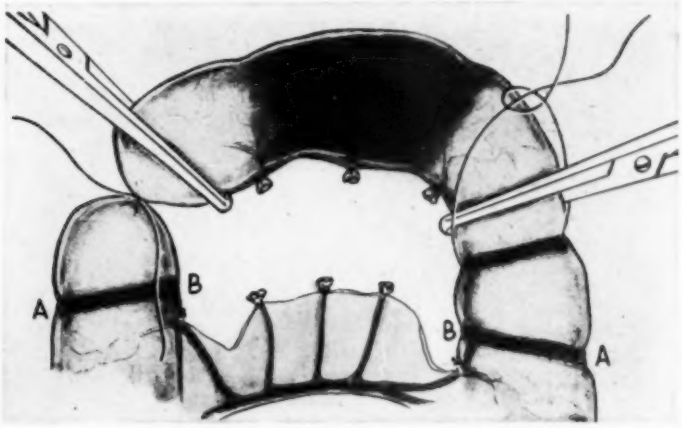
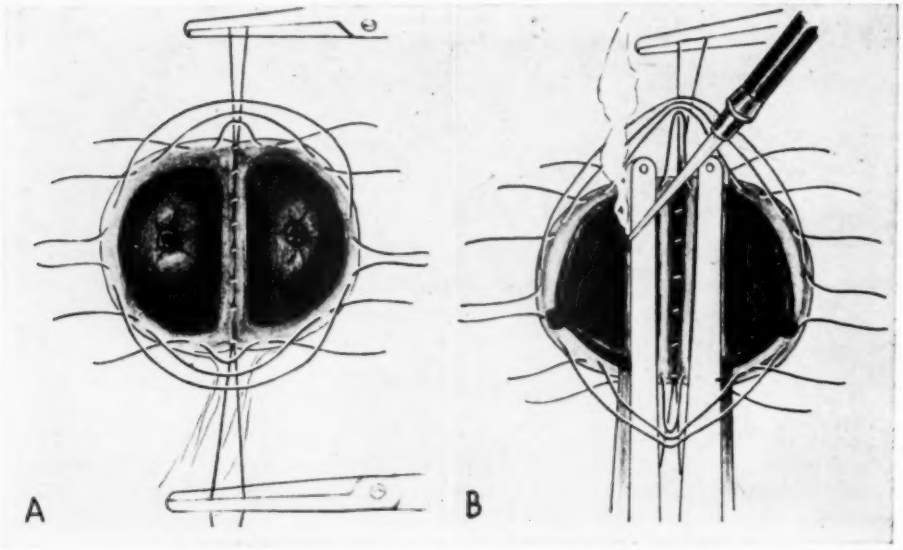


FIG. 4. Resection of piece of bowel for end-to-end aseptic anastomosis. Segment to be removed is crushed and tied at each end, and is then amputated by cautery as shown. Next each end is crushed along lines AB which make an angle of about 25° with intact part of mesenteric border. It will be seen that bowel ends are thus closed by short cone-shaped bulkheads of devitalized bowel wall. Crush marks serve as guides for insertion of sutures. Note that cutting back of amesenteric border increases lumen of anastomosis. Note also ties placed around vessels of mesenteric border behind crush marks.

plete paralysis of the bowel. This can be observed readily in the experimental animal and is often seen in the human subject. When it has reached a certain degree of severity and has been present for a considerable time, it is inevitably fatal. As a result of partial or complete paralysis, the bowel loses the power to propel its contents. Following enterostomy, it may gradually resume activity, but it may require several days for recovery.

It is evident that an intestinal anastomosis done under these conditions may not deflate the bowel soon enough to save the patient's life. Its effect may be limited to releasing the pressure in the loop just proximal to it, because the gas higher up is trapped by kinks on the paralyzed bowel. Furthermore, if considerable volumes of gas or other bowel content are forced through the anastomosis by peristaltic action, they cause a dangerous strain on the sutures. If a partial or complete obstruction due to adhesions or feces is present distal to the

anastomosis it will be subjected to increased intra-intestinal pressure, which will imperil the circulation of the sutured ends. In addition to all this we must bear in mind the increase in



FIGS. 5A and B. End-on views showing one method of performing aseptic end-to-end anastomosis after bowel ends have been prepared as shown in Figure 4.

A. Closed ends united from mesenteric to amesenteric border by continuous stitch, ends of which are kept long. This completes half of suture line. Interrupted Cushing stitches are shown so placed as to complete other half of suture line.

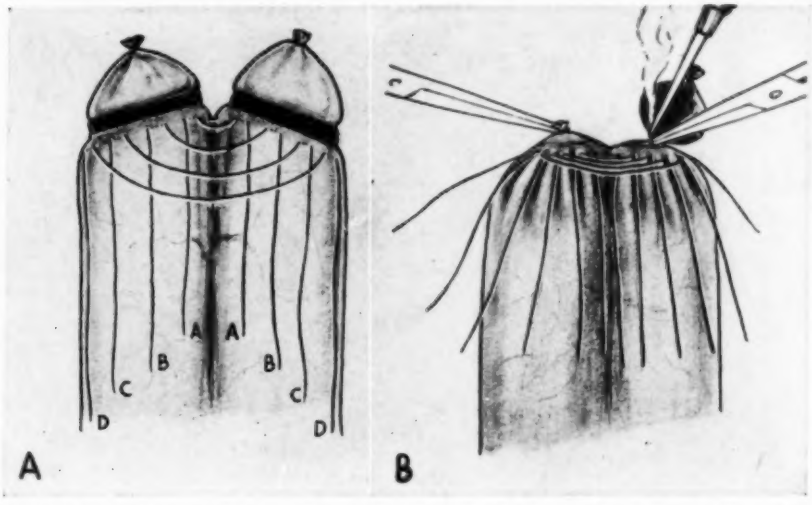
B. Clamps have been inserted across bases of the bulkheads, one of which is being burned away. Operation is completed by tying interrupted sutures, after clamps have been removed. Coaptation produced by clamps is sufficient to seal off lumen of bowel until stitches are tied. This method works very well on a large piece of intestine which is perfectly empty.

number and virulence of the intestinal bacteria which is caused by obstruction.

PREPARATION FOR INTESTINAL ANASTOMOSIS

In the light of the foregoing, we conclude that intestinal anastomosis, by any technique, is dangerous until the systemic and local effects of intestinal obstruction have been overcome. To attempt the operation on a patient suffering from dehydration, the changes in blood chemistry which attend it, and with intestines distended by gas or feces, is to invite a fatality. The

patient should first be given adequate amounts of salt solution by the intravenous route. Next the obstruction should be relieved by simple or by gun-barrel enterostomy as the require-



FIGS. 6A and B. Diagrams illustrating second method of completing aseptic end-to-end anastomosis.

A. Plan of inserting sutures.

B. Method of removing bulkheads. Operation is completed by tying stitches in order from mesenteric to amesenteric border. Clamps are removed as stitch at amesenteric border is being tied. This method is to be used when intestine is of small size.

Both methods of end-to-end suture are completed by a continuous Cushing suture placed close to inner row of interrupted stitches. Flange turned in by these methods is very short and there is no possibility of a purse-string action in line of suture.

ments of the situation may demand. Once these primary indications have been met, bowel resection may be postponed indefinitely until the general condition of the patient is good, and until the damaged intestine has had time to recover completely. We now have methods whereby we can give parenterally and for a prolonged period adequate quantities of water and nourishment, and also methods whereby the bad effects of high enterostomy may be prevented.

The foregoing remarks apply chiefly, of course, to the preparation for bowel resection when complete obstruction is present. The necessary preparation for the same operation when only partial obstruction is present consists in getting the

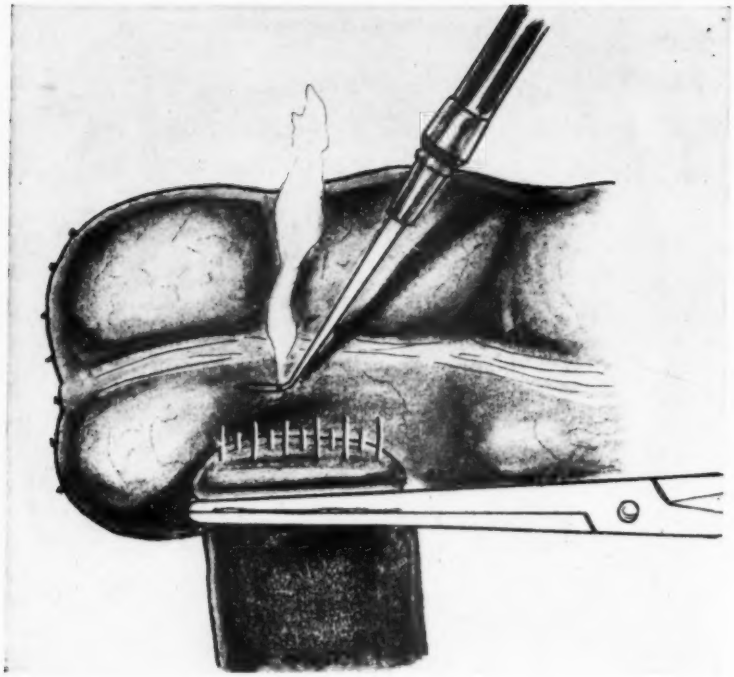


FIG. 7.

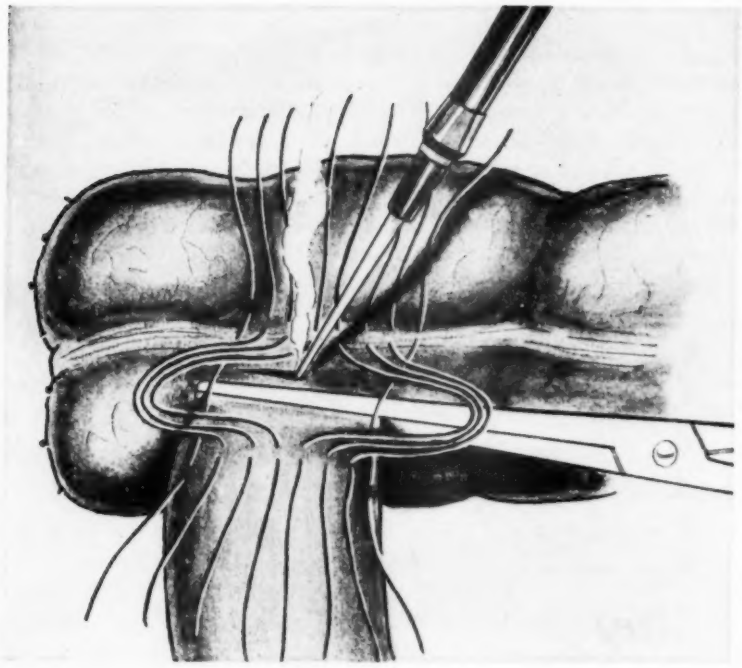


FIG. 8.

FIGS. 7 and 8. Method of end-to-side anastomosis. Note that end of ileum is clamped at right angles to its mesentery. Technique is identical with that for lateral anastomosis, except that opening in one side is closed by clamp until moment before inner row of anterior sutures is tied.

intestines empty, and in using every possible means to improve the general condition of the patient. Done on a bowel which is empty and in good condition, and on a patient in a satisfactory

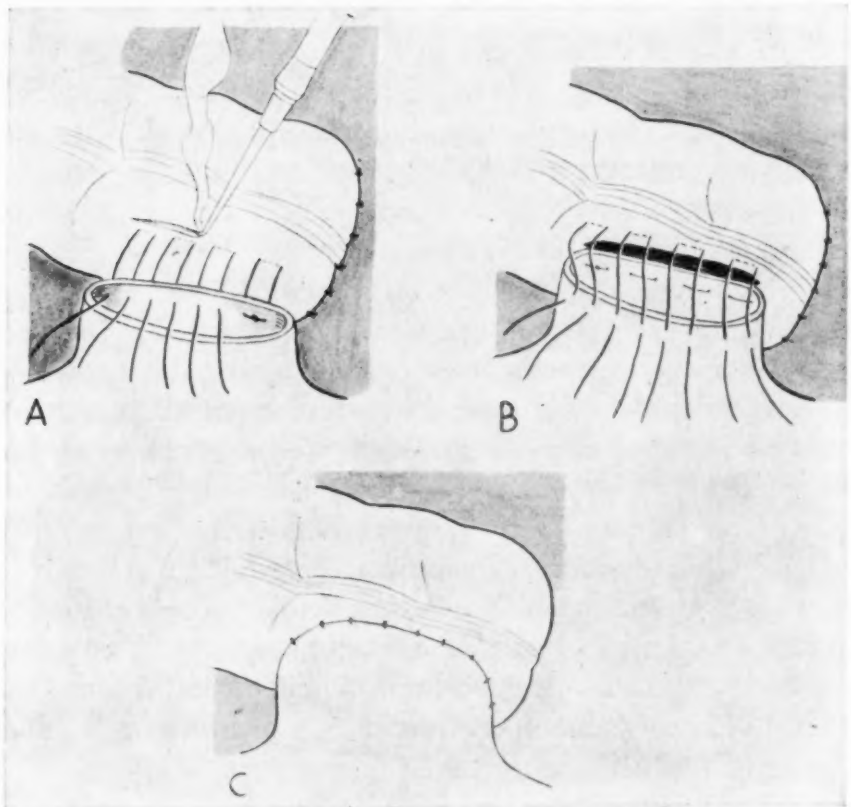


FIG. 9. Method used successfully in one case of suturing a short stump of rectum to side of sigmoid. Of course, no attempt at asepsis was made, but method of inserting sutures is similar to that used in aseptic operations. By placing all stitches of inner row of anterior suture line before tying them, it was possible to insure accurate approximation of serous surfaces, though the work had to be done in very bottom of pelvis.*

state of health, intestinal anastomosis is not a dangerous operation. It can then be done with satisfactory results by either the open or by the aseptic technique. Otherwise, it is dangerous no matter how it is done.

*All these anastomoses can be made almost completely aseptic by using electrocoagulation to establish the openings in the bowel.

This procedure, however, does not insure an immediate opening of the anastomosis.

ASEPTIC INTESTINAL ANASTOMOSIS

While I do not regard an aseptic technique as of paramount importance, I do regard efforts to develop it as interesting, and worth while. I shall therefore devote the remainder of this paper to a brief consideration of the subject together with a description of some methods of aseptic anastomosis which I have found satisfactory by prolonged clinical trial.

I have been interested in the aseptic technique for intestinal anastomosis, since I assisted Dr. W. S. Halsted in his first experiments in this field of surgery in 1909. Since that time, the subject has been studied by a large number of surgeons, and many methods of performing an aseptic anastomosis have been invented or re-invented. It is of interest to determine how widely these methods are used at the present time in human surgery. I have refrained from sending out a questionnaire, but have tried to answer the question by consulting current textbooks and systems of surgery published in the last ten years. The subject is mentioned in four of the twelve works we consulted. It is discussed in the textbooks of Babcock, DaCosta and Horsley, and in Lewis' Practice of Surgery. But none of these assign to it more than a limited field of usefulness.

It would seem, therefore, that the subject of aseptic anastomosis is of too little importance in the view of the writers of most of our current textbooks of surgery to be mentioned. Furthermore, we can hardly doubt that they express by their silence the opinion of most surgeons. DaCosta says: "In practical surgery aseptic methods of intestinal suture are usually a failure." Sweet asserts that aseptic suture is impossible and inadvisable. It is unfortunate that the ridicule which has been heaped upon Professor Halsted's idea that it is possible to engage a suture in the submucous coat of the bowel without having it penetrate the mucosa, has done much to discredit methods of anastomosis. The majority of surgeons apparently do not regard asepsis as very important in performing intestinal anastomosis. They feel that after all it is impossible, and that

efforts to attain it are liable to result in insecure closure, hemorrhage, or obstruction at the site of union. But the aseptic technique is not without influential supporters. Among these Rankin has probably done more than anyone else to keep the subject alive.

In 1912, the writer published the results of an experimental study of aseptic anastomosis. The conclusion was stated in this paper, that aseptic anastomosis is theoretically impossible, but practically attainable. Cultures made from along the line of suture were sterile. Threads pulled through the bowel walls just as they are used in suturing were found to be sterile in nearly all tests. The experiments demonstrated that the "contamination from the suture is so slight that the tissues are well able to cope with it." Prolonged clinical trial has now demonstrated the soundness of these results.

I have found the methods reported in 1912 so satisfactory that I have decided to report them again with improvements which I have made from time to time, and with the advantage of adequate illustrations. I advance the following claims for the technique employed.

1. That it is safe, easy to carry out and adaptable to every location where an intestinal suture is required, suture of the stomach excepted. Here, I do not consider any kind of aseptic suture safe because of the danger of hemorrhage.

2. That it requires no instruments not in the possession of every surgeon.

3. That it makes possible primary healing of the abdominal wound in most cases after resection of the colon. This is a practical test for the efficiency of any aseptic technique.

4. That the completed anastomoses have practically the same sutures used in the best types of open operation, and that they are therefore just as secure and trustworthy as the latter.

In clinical surgery, I always use the lateral anastomosis, because I think it safer, and because I have never observed any disturbance of intestinal function as a result of it. Radiographs

show almost no deformity of the bowel at the site of operation. To secure the best possible functional result, the openings in the intestine should not be made over 1½ inches in length, and care should be taken to make the blind ends of gut as short as possible. Bad function is more liable to result from too long an opening than from the blind ends.

After observing the results of numerous end-to-end anastomoses, done on the experimental animal by every conceivable technique, I have been convinced that the operation is more dangerous than the lateral suture, and that in the small bowel, it is actually more liable to give a bad functional result. When subjected to pressure, it is more liable to leak. Constriction due to purse-string action of the sutures or due to the inversion of too wide a flange, may cause a partial obstruction. Furthermore, peritoneal adhesions to the suture line are more liable to cause complete obstruction at an end-to-end anastomosis than at a lateral anastomosis. I feel that the longer time required to make the lateral anastomosis is well spent.

While, I think, the method of end-to-end suture illustrated here is as safe as any method, open or aseptic, designed for this purpose, I do not advocate its use for human surgery.

CLINICAL RESULTS

In the last five years I have used the method illustrated above for 12 resections of the large bowel, for 5 resections of the small bowel, and for 8 short-circuiting operations on the large bowel. I have also used it in a number of cases for the making of enteroenterostomy in conjunction with anterior gastroenterostomy.

Among the 12 resections of the colon there were 2 deaths in the hospital, the remaining 10 patients are all still alive and free from any evidence of recurrence. In 5 of the 10 the abdominal wounds healed by first intention. Of the 5 patients who developed wound infection, 3 had preliminary cecostomies. In the other 2, the infection was slight and did not interfere with firm wound healing. No patient had a postoperative hernia.

All the anastomoses were either lateral or end-to-side. All of them, except those following resection of the cecum, were protected by preliminary cecostomy, or by "non-leaking" cecostomy done at the time of resection. Three patients, all of whom recovered, were over seventy years of age. Two patients were sixty-nine and one was sixty-five years old. The age of the remaining 6 patients ranged from thirty-five to fifty-nine years.

Among the 5 resections of the small bowel there was one death. This followed resection of 6 feet of totally gangrenous bowel for mesenteric thrombosis.

The 8 short-circuiting operations on the colon, with two exceptions, were all done for advanced and hopeless cancer. In this group there were 2 deaths in the hospital.

CONCLUSIONS

1. Intestinal anastomosis should be regarded as the final step in the cure of intestinal obstruction. It should not be done until the patient has recovered completely from the local and systemic effects of obstruction. Neglect of this principle is probably a more important cause of death after the operation than is faulty technique in its performance. Done on an intact patient who has a clean bowel intestinal anastomosis should not be a very dangerous operation.

2. Distention of the bowel makes it anemic, and jeopardizes the success of any intestinal suture. Intestinal anastomosis should not be done before the bowel has recovered completely from the effects of distention. Every possible precaution should be taken to prevent distention of the anastomosis after operation.

3. An aseptic technique is preferable to an open technique provided it can be carried out as readily, and provided it insures as trustworthy a result. The technique illustrated has been found by clinical trial to meet these requirements.

4. The short lateral anastomosis should be preferred for human surgery to the end-to-end suture. It is safer and gives as good or better function.

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PRE-COLOSTOMY FOR INOPERABLE CARCINOMA OF THE RECTUM AND LOWER SIGMOID

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THE term pre-colostomy does not refer to preliminary colostomy, but is used to designate a procedure to be described in this paper. Perhaps many surgeons are already using it, but the writer does not recall having seen it described in print, and does not believe that its advantages are generally recognized.

The surgeon who deals with many cases of malignancy of the rectum and lower sigmoid will unfortunately find a considerable number that are clearly unsuitable for attempts at radical surgical removal. Often this fact can be determined at the first examination. It is not uncommon, however, to explore the abdomen in the hope of performing a radical resection, only to discover that the growth has involved the bladder, that there are peritoneal implantations, that the liver is involved by metastases, or that some other complication makes extensive surgical removal futile. In such a situation, the question of some palliative operation arises. When the growth is in the higher parts of the colon, a resection or short-circuiting anastomosis is logical and practicable, but in the distal large bowel neither of these methods is available. What usually happens is that the surgeon tries to decide how imminent the onset of obstruction appears. If the patient's symptoms and the examination of the growth indicate that in a short time the lumen will be practically closed, it is customary to do a colostomy, usually in the sigmoid, at the time of the exploratory laparotomy. If, on the other hand, there is no especial reason to anticipate early obstruction, many surgeons simply close the abdomen, being reluctant

to inflict a colostomy that is not immediately necessary, and hoping that the disease will terminate life before it may become necessary. It is in such situations that pre-colostomy offers an alternative with distinct advantages.

This procedure, which the author has perhaps unduly dignified with the title of "pre-colostomy," consists quite simply in doing what amounts to an ordinary colostomy with the exception of the final step of actually opening the bowel. It is designed to prepare for an actual colostomy, should such become advisable, without the need of subjecting the patient to a second operation. It is, of course, necessary to attach the bowel to the abdominal wall in such a way that it will be readily accessible for later opening, and yet so that the passage of contents through it at the attached point will not be interfered with. Therefore only the tangential form of colostomy can be employed and the blood supply of the sigmoid must not be disturbed. In practice, the writer has proceeded as follows. With the abdomen still opened by the original exploratory incision, a small left-side McBurney incision is made, usually only 1½ to 2 inches long. A point in the sigmoid that is most convenient is selected, and the bowel at this point is gently drawn up into the McBurney incision until about one-fourth of its circumference extends beyond the skin level. It is fixed at this point by a few stitches to the skin, no other sutures being used. Care must be taken that the incision in the peritoneum is not small enough to pinch the cone of bowel that is drawn through it. The principal exploratory incision is then closed and both wounds dressed together under one dry dressing.

The postoperative handling of the case will depend upon developments. The writer has been following this practice for a number of years, and in that time has done perhaps twenty such pre-colostomies. In one instance, a few months ago, obstruction symptoms became quite pronounced within six days after operation and the knuckle of bowel was opened, completing the colostomy. This relieved the obstruction at

once and when last heard from the patient was still living in the same condition that would have resulted had an immediate colostomy been done. In another case, the patient was insistently opposed to colostomy. He was found to have extensive liver involvement at the exploratory operation, and a pre-colostomy was done. He succumbed to the disease twelve days after operation, without developing obstruction and without having the actual colostomy performed. A third patient recovered from the operation, went home and resumed his affairs, began to become obstructed about three months later, and then had the sigmoid opened. A fourth patient, a man of seventy-three with several nodules in his liver, has now gone ten months in comparative comfort without yet needing to have the colostomy completed.

This last case, the longest in duration so far of several that have escaped colostomy for a considerable time, illustrates well what happens to the knuckle of gut fixed in the abdominal wall. The serosa soon is rubbed off by the dry dressings, and epithelium from the skin begins to grow over the small protruding surface of bowel. In a few weeks this is completely covered with a thin epithelial layer and no more dressings are required. There is, of course, a bulging, in fact, the patient has a small ventral hernia containing the attached loop of sigmoid. If it becomes necessary to open the bowel, a small incision, without any anesthesia, suffices to admit a tube to the lumen of the sigmoid and the operation of colostomy is finally completed, perhaps months after the original operation was performed.

The advantages of this procedure are obvious. It avoids the necessity of a second operation for obstruction, should such a condition develop, even months later, and it also avoids the disagreeable features of a colostomy until such time as a colostomy becomes imperative, which may never happen. In short, it provides the patient with a colostomy ready-made but only to be opened when needed. It might be objected theoretically that the kinking of the bowel by being fixed

in the abdominal incision would itself precipitate obstruction. As a matter of fact, however, this development has not been observed, and should it occur, the opening of the fixed loop would relieve the obstruction. The addition of the pre-colostomy operation to the exploratory incision is a matter of such slight weight as to be unimportant in most cases. Indeed, so useful has this simple modification of the usual colostomy technique proved itself and so few are the surgeons who apparently employ it, that the writer has felt justified in this brief publication to bring pre-colostomy into general recognition and utilization.

A METHOD OF TREATING

IRREDUCIBLE PROLAPSE OF THE RECTUM

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CINCINNATI, O.

IN a large charity service one occasionally encounters instances of neglected prolapse of the rectum which cannot be reduced by the ordinary non-operative procedures. In rare instances the condition is so bad that obviously no attempt at reduction should be made. Such instances of irreducible prolapse are usually the result of neglect and are complicated by excessive edema, infection, ulceration and areas of necrosis. Occasionally one will encounter a true strangulation of the prolapsed rectum.

It is in connection with this type of irreducible prolapse of the rectum and not with the prolapse of the anal mucosa or of an intussusception through the anal canal, that the author wishes to describe the operative procedure which he has been using.

Its first application was in 1925:

A Chinese girl, aged eight, was admitted to the Peking Union Medical College Hospital with an edematous and sloughing prolapse of the rectum which was about 5 inches in length. The condition had been present for a long time and it was obvious that no attempt should be made to reduce it. The external opening of the gut was at the apex of the protruding mass. There was no evidence of intestinal obstruction. It was easy to insert a rubber tubing, about an inch in diameter, into the prolapsed rectum and to pass it through the sphincters well up into the rectum. With this tube thus placed several of us palpated the prolapse surrounding it and were sure there was no herniation of intestine into a peritoneal pouch. At the junction of the skin with the mucosa the edema was less and it was at this point that palpation was most satisfactory and convincing. Consequently the tube was anchored in situ by means of a couple of heavy silk sutures at the apex of the prolapse. Next a constricting rubber band was placed around the prolapse at the normal surface level of the anus and just distal to the

external sphincter muscle. This band stopped the circulation to the prolapse and also occluded any peritoneal pouch that might have been present. For several hours the child was watched most carefully for evidences of

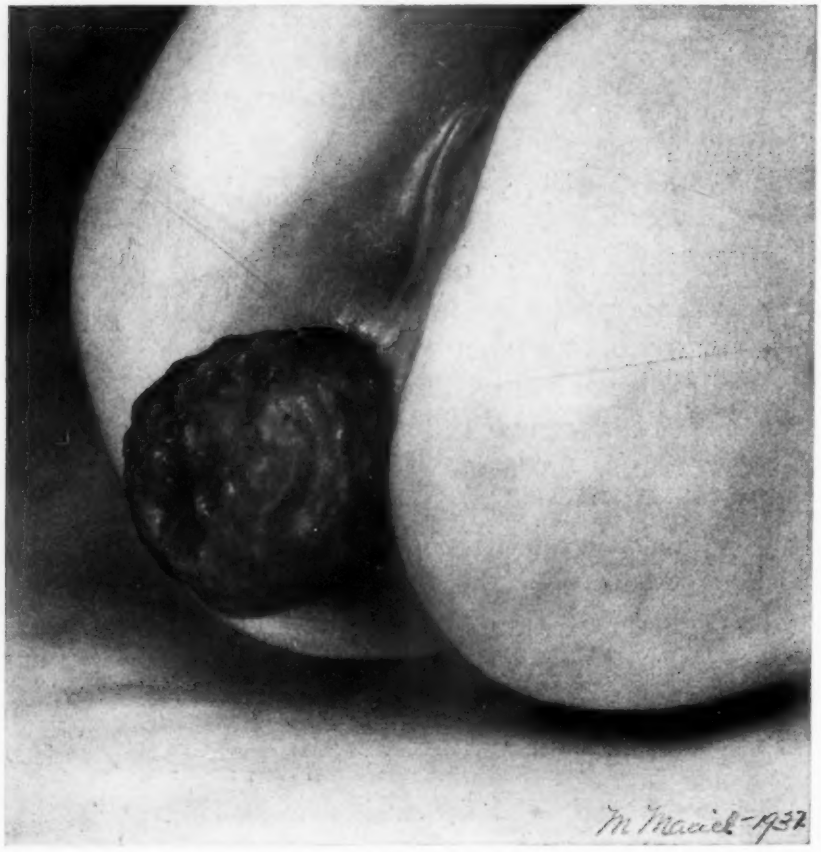

FIG. 1. Edematous, ulcerated and irreducible prolapse of rectum.

intestinal obstruction. At the end of two weeks, during which time there was normal defecation and expulsion of gas through the tube, the entire prolapse sloughed away. A spontaneous anastomosis had occurred at the level of the rubber band. Tone quickly returned to the muscles and at the time of her discharge from the hospital there was good sphincter control and no evidences of rectal stricture. We believed that this procedure had definitely lessened the chances of peritonitis which would have attended surgical amputation of the prolapse and suture in the presence of so much infection and necrosis.

A similar procedure was employed on another patient in the same hospital and with as satisfactory result. In the clinic

of the Cincinnati General Hospital there have been two other occasions when we felt that this method of treating an irreducible prolapse of the rectum was justified. In both in-

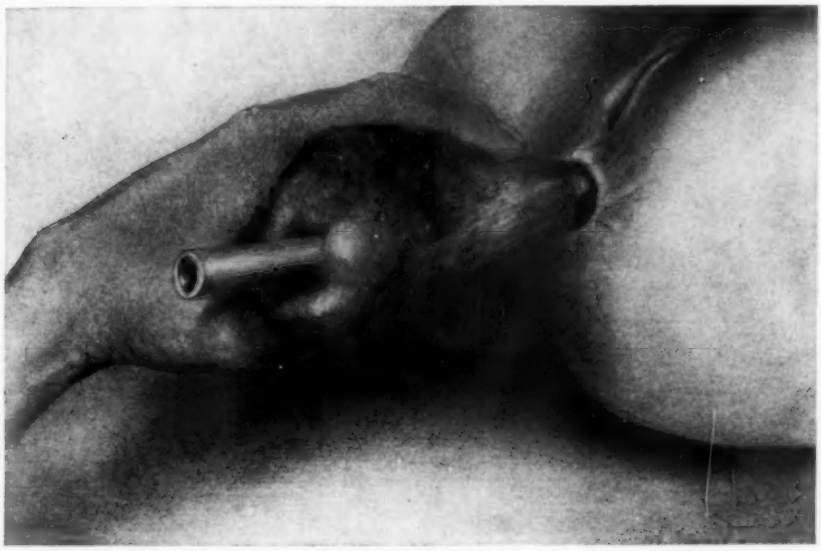

FIG. 2. Prolapse of rectum is pulled and a rubber tube, about one inch in diameter, is inserted through sphincters well up into rectum. Spontaneous amputation and anastomosis occur as a result of constricting rubber bands, which are placed distal to sphincter muscles. This method cannot be used when there exists a hernia sac containing abdominal viscera.

stances the patients were adults and the prolapses had become irreducible and badly ulcerated at the time of their first appearance. There has not been an opportunity to follow the subsequent history of the Chinese patients. It has now been over three years since we operated upon the last of the two patients in our clinic in Cincinnati and both of them have remained well. Sphincter control has remained good. There is no stricture.

In presenting this method of treating an irreducible prolapse of the rectum we are fully aware of its dangers and limitations. It is quite obvious that there must be no intestine or other abdominal organs in the hernia sac of the prolapse. In the instances in which we have employed it we have been able to determine this by palpation over the tubing. In the case

of any doubt about the contents of the sac it would be mandatory to make roentgenological studies before proceeding. Our main reason for using rubber bands rather than ligatures

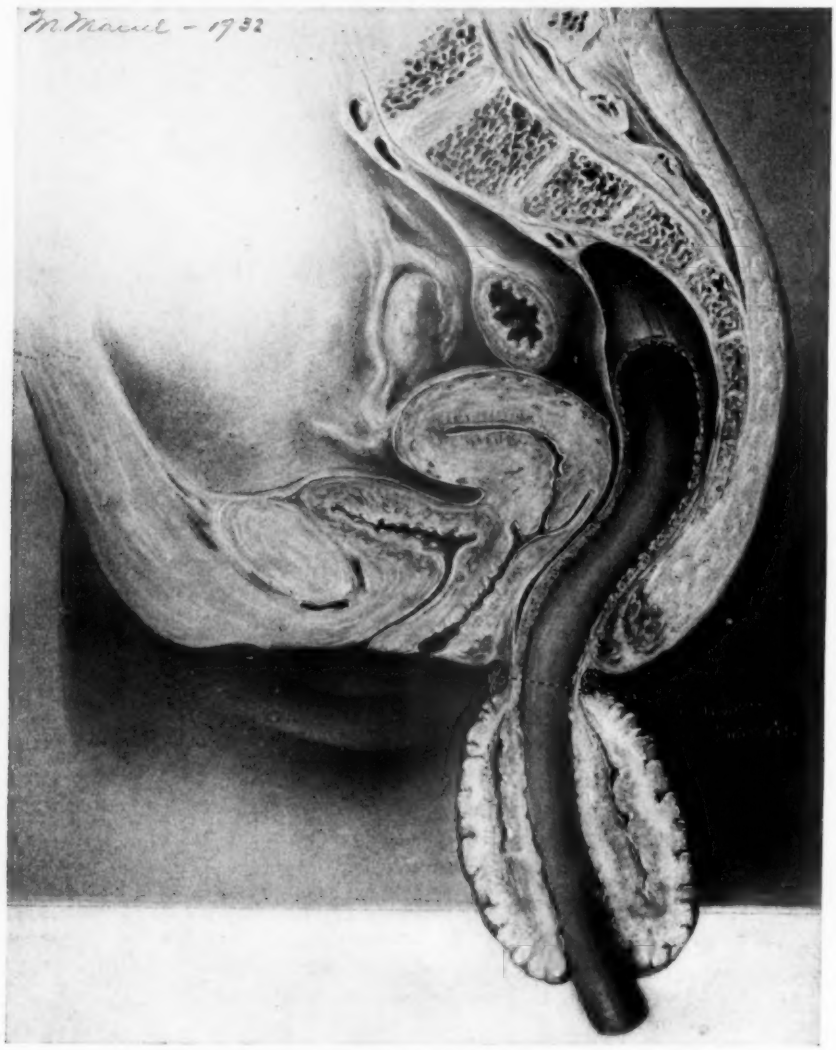

FIG. 3. Cross section of illustration shown in Figure 2.

of silk was the ease with which they could be removed at the first signs of intestinal obstruction. When the neck of the prolapse is very large, when the sphincter muscles are completely atonic and when there is obvious perineal herniation due to

congenital or traumatic muscular and fascial weakness, the method of treatment described is contraindicated. However, when such conditions exist the prolapse is almost never irreducible.

SUMMARY

In the treatment of irreducible and strangulated prolapses of the rectum it seems to us that the method described and illustrated offers, when its use is not definitely contraindicated, a simple solution to a very difficult problem and should lessen very materially the danger of peritonitis. This method or its principle may prove to have value in the treatment of certain types of recurring prolapses in adults, and possibly in connection with total excisions of the rectum when there is any endeavor to restore the anus and to retain normal sphincter control.

DISCUSSION

Dr. Rudolph Matas, New Orleans, La.: Dr. Reid's work is in close harmony with mine. We have been attracted by the same subjects and have had many experiences and ideas in common. It is interesting that in dealing with intractable prolapse of the rectum, I performed a radical operation thirty-eight years ago which in principle was identical with the operation just described by Dr. Reid. This operation was performed in 1894 on a male infant with a well-formed anus, but a completely imperforate rectum. The case is fully described in a paper.* In this case the septum separating the proctodeum from the enteron was very high and in order to bring the closed bowel to the anal outlet I had to do a Kraske resection of the coccyx and part of the sacrum. By uniting the enteron to the proctodeum the normal anal outlet was restored. The child recovered from the operation, but developed whooping cough which in consequence of the weakened pelvic floor was followed by complete procidentia of the rectum which allowed the rectum to remain permanently extruded from the anal outlet. As no palliative treatment availed to give the baby relief, I decided to excise the prolapse. This was done twenty-eight days after the first operation. The prolapsed bowel then constituted a true hernial sac in which coils of the small intestine could be felt. By carefully excluding these the

* *New Orleans M. & S. J.*, July, 1897.

base of the prolapsed bowel was transfixed and ligated with elastic ligatures in two sections. The ligatures were held in place and prevented from slipping by two hat pins which transfixed the prolapse at its base close to the anal margin. In this way complete hemostasis was secured and the prolapsed mass was totally excised in two sections which were closed by a circular suture. This excluded the peritoneal cavity, completely prevented hemorrhage and brought the mucous surfaces in apposition. In this way the prolapsed mass was bloodlessly amputated and the continuity of the recto-anal canal restored.

The little patient recovered from this operation without any serious consequences. For many years the child suffered from imperfect continence of feces, but as he grew up he obtained a perfect anal control and is now a successful and prominent lawyer.

Since that time I have performed amputation of the rectum for irreducible prolapse in 3 cases, all in young subjects and with uneventful recoveries. In other cases of reducible prolapse the methods of intraperitoneal rectopexy and sigmoidopexy and the more classical methods proved sufficient and successful. I believe the only difference between Dr. Reid's operation and mine is that he allowed the strangulated prolapse to slough off and that I cut it off at the same sitting. I am quite sure that in aggravated irreducible and strangulated cases of procidentia recti such as described by Dr. Reid, the operation is simple, safe and expeditious, if performed by the technique described.*

Dr. Mont R. Reid (*Closing*): I felt that my procedure was so simple that it must have been described or at least used a great many times. A few years ago when I looked up the matter I thought I ran across an article that was very similar to the one I read this evening, but during the last few months I have searched carefully and have been unable to find it.

Dr. Matas' description of the procedure he used for prolapse of the rectum reminds me very much of the treatment that was once employed for cirsoid aneurysms of the scalp when, as you know, the growths were punctured with needles and then rubber bands were placed around the growth between the needles and the scalp. As a result of these constricting bands the tumor mass would slough away.

* Apparently, Kleberg was the first to apply the principle of elastic constriction to these cases, in 1891 (see Kelley's Diseases of the Rectum, 1896, and Sajous' Annual, Sect. D., p. 27, 1891). Those interested in rectal prolapse as a complication of Kraske's operation for congenital imperforation of the rectum will find a full discussion in the author's monograph on the "Surgical Treatment of Ano-rectal Imperforation in the light of Modern Operative Procedures" (*Trans. Am. Surg. Assn.* 1907, pp. 1–101; *Am. J. Obst.* 36: no. 5, 1897; and in Keating-Edwards' Cyclopedia of Diseases of Children, 1899, Vol. v).

Doctor Matas' discussion convinces me that when one has written a paper and looked up all the literature that he can find he should then write to Doctor Matas and find out what he has done along similar lines. In this instance I may be excused to a certain extent for not finding his article since it was published under the title of "Congenital Imperforate Rectum." The principle of his procedure is essentially the same as I have reported but I believe that the large rubber tube reduces the chances of a stricture and that not puncturing the cul-de-sac by means of pins must lessen materially the chances of peritonitis.

SYPHILIS OF THE STOMACH

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SYPHILIS of the stomach has aroused sufficient interest to provoke reports of numerous cases treated medicaly and an occasional case surgically, and to promote discussion as to the frequency of its occurrence. It is not a frequent finding at autopsy upon syphilitics. Chiari[5] found 2 instances in 243 cases, Symmers[18] one in 316 cases, Stolper[17] one in 86 cases, and Windholz[20] 2 in 376 cases. In fact, the gastrointestinal tract seems fairly immune to attack by the Spirochaeta pallida in comparison to the frequency with which the cardiovascular, osseous, and nervous systems are invaded.

The earliest report of syphilitic disease of the stomach has been credited to Andral[11] in 1834, by Hartwell[10] who in 1925 made a most comprehensive review of the subject. He points out that Chiari,[5] in 1891, after a careful survey of the literature and painstaking study of 243 autopsies of known syphilitics, indicated the necessity of basing the diagnosis of syphilis of the stomach upon histological evidence only. Chiari was willing to accept as beyond question only 7 cases reported up to that time and two of his own demonstrated at autopsy. His dictum remained the dominating influence until the advent of the Wassermann reaction and gastrointestinal roentgenology, when again many reports appeared based on these as criteria and not on histological evidence. Hartwell has thoroughly culled the field, indicated again the fallacy of basing a diagnosis on the therapeutic test in spite of favorable *x*-ray findings, reviewed the subject exhaustively and accepted 27 cases up to 1925 beyond the question of a doubt.* He further asserts most emphatically

*Ten cases reported by Eustermann apparently confirmed histologically are not accepted by Hartwell because of insufficient detail.

from a diagnostic standpoint the importance of differentiating between true syphilitic ulcer of the stomach and gastric ulcer or other gastric lesions in syphilitics. Since 1925, Windholz[20] has reported 3 cases, Kwartin and Heyd[11] one, McCann and Dumphy[12] one, Sudek two (Talia[19]), Morton[15] one, and Harris and Morgan[9] one (36 in all), that follow this rigid criterion, i.e., have been proved histologically from resected specimens. In only two instances have the spirochetes actually been demonstrated; first by McNee[13] in 1921, and again by Harris and Morgan[9] in 1932. Hartwell's strict measuring stick would seem to be necessary for a positive irrefutable diagnosis, though highly suggestive diagnoses can be made in cases that have characteristic radiographs, gastric analyses, and respond to antiluetic treatment as demonstrated by roentgenographic as well as clinical improvement. Non-syphilitic gastric lesions in syphilitics are so common that a positive diagnosis of gastric syphilis without histologic proof is exceedingly difficult to substantiate beyond the peradventure of a doubt, though it must be admitted that syphilis of the stomach, though rare, must be more frequent than the reports of *operated* cases indicate. As Cheney[4] states (1928):

> Syphilis of the stomach wall is undoubtedly a rare disease, but just how rare depends upon what proofs are demanded for its diagnosis. If histologic and bacteriologic examination of tissues is required, then less than 50 cases have been reported. But if history, blood Wassermann reaction, *x*-ray films, and response to therapy are considered adequate, the number of cases recorded in literature becomes much larger but still does not reach three hundred.

PATHOLOGY

Syphilis of the stomach occurs as either:

1. A gumma or ulcer that involves the pylorus or antrum of the stomach, or,

2. A diffuse involvement of practically the entire stomach resembling a linitis plastica. The walls become contracted, markedly thickened, and peristalsis of the involved area is greatly diminished.

Chiari's conclusions after his exhaustive pathological study have been universally corroborated:

1. Syphilis produces actual changes in the stomach.
2. They may be direct or indirect.
3. The former are gummatous or inflammatory infiltration.
4. Gumma may occur in both hereditary and acquired syphilis.
5. Gumma always apparently *first starts in the submucosa* and extends from there into the other coats.
6. "Through the breaking down of the gumma, particularly because of the action of the gastric juice and the obliteration of the blood vessels, ulcer, and ultimately scars may form. Even perforation may occur." (Flexner)
7. The indirect effects are due to syphilitic changes in other organs such as the liver, and are relatively frequent.

The resected cases and *x*-ray studies indicate that the lesions are most commonly in the antrum or prepyloric (Windholz) portion of the stomach, either polypoid gumma (Graham[8]), or diffuse thickening of the distal portion (Harris and Morgan, Morton), though the entire stomach, especially the submucosa (McCann and Dumphy), may be involved in a linitis plastica type of lesion (Mousseau).[16]

Ulcers may be single but more often multiple and usually serpiginous in character, often large (as much as three-fifths of the stomach in area, McNee), with an extensive thickening about them, particularly in the submucosa which may be from eight to ten times normal thickness. Spirochetes in the lesions have been demonstrated only by McNee, and Harris and Morgan, the latter producing testicular syphilis in rabbits by an injection of a suspension of the suspected gastric lesion. McNee has indicated painstaking search may be necessary to demonstrate their presence in the lesion as he was successful only after examining eight separate blocks of tissue.

Microscopically, there is extensive infiltration with plasma cells, lymphocytes and eosinophilic leucocytes, but chiefly lymphocytes, and largely perivascular. Obliterating endo-

phlebitis and endarteritis are further characteristics. Giant cells may be present and occasionally miliary areas of gummata or necrosis.

DIAGNOSIS

It is generally agreed that luetic gastric lesions are found more often in males because females are less frequently infected with syphilis. There are no characteristic symptoms but there are certain observations besides a positive Wassermann reaction upon which may be based the suspicion of syphilis of the stomach:

1. Anacidity or a greatly reduced acidity. Eusterman[6] in a study of 93 suspected cases found achlorhydria in 85 per cent. In Graham's,[8] and Brams and Meyer's,[2] and in McNee's proved cases no free hydrochloric acid was found.
2. Marked contraction in size of the stomach with a tendency to hour-glass deformity as demonstrated by roentgen examination. Carman[3] has summarized the *x*-ray characteristics as follows:
    a. Filling defect of the gastric outline, usually without corresponding palpable mass.
    b. Shrinkage of gastric capacity.
    c. Stiffening and lessened pliability of the gastric wall.
    d. Absence of peristalsis from the involved area.
    e. Pylorus gaping rather than obstructed.
    f. Six hour retention less common than in other gastric lesions.
    g. Hour-glass stomach. Upper loculus expanded and bulbous, lower loculus tubular due to extensive irregular concentric contraction.
    h. Patient usually under the cancer age and not ill in proportion to the extent of the disease. "There is an absence of palpable mass, the patient may be under the cancer age, he is anemic rather

than cachectic, and has not lost weight and strength in proportion to the extent of gastric involvement and duration of the trouble."

Moore and Aurelius[14] have found roentgenologically the involvement may be classified as:

1. Prepyloric in type in 70 per cent.
2. Median or dumbbell hour-glass type in 22 per cent.
3. Widely diffuse in 8 per cent.

CASE REPORT

As instances of gastric syphilis based upon histological evidence in the resected specimens are still comparatively few, it has seemed worth while to record the following case:

A woman, aged thirty-eight years, admitted November 22, 1929, complained of pain in upper left abdomen and vomiting. Married sixteen years, no pregnancies or abortions. For three years she had had occasional abdominal soreness after eating. Eighteen months before admission she began to have sudden gnawing pain in the upper left abdomen, especially between meals when the stomach was empty, lasting for two to three minutes, then subsiding for an interval and again recurring. She would have periods of relief for a week or two and then two or three weeks of constant discomfort.

Gradually, for the last six months food seemed to "stick in her throat," then pass into her stomach, but in a few minutes it would be vomited up. She had lost 33 pounds in weight and for three months had retained very little, if any, food. There was no melena or hematemesis.

Physical Examination: Rather emaciated, pale woman. Examination essentially negative. No general glandular enlargement. Pupils react normally. Pain of complaint located just beneath and also above ensiform cartilage. No tumor or mass. No rigidity.

Pelvic examination negative. Blood: W.B.C. 9300; R.B.C. 5,280,000; Hb. 80 per cent. Urine negative.

X-ray showed a small stomach with hour-glass contraction in the antrum, apparently due to an ulcer (Fig. 1).

No gastric analysis was obtained as a Rehfuss tube could not be retained.

Preoperative Course: Under daily lavage, liquid diet, and nutritive enemata the patient stopped vomiting, retained all liquids, and improved

sufficiently in three days to justify operation. Preoperative diagnosis was gastric ulcer with hour-glass deformity. Syphilis was not suspected.

Operation: Midline epigastric incision. The stomach was found to be

FIG. 1.

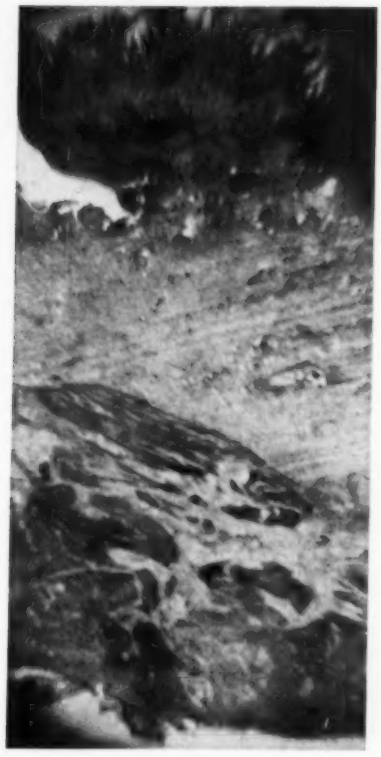

FIG. 2.

FIG. 1. Radiograph before operation showing very small stomach with hour-glass contraction in antrum.

FIG. 2. Very low power photomicrograph showing entire stomach wall, margin of ulcer in mucosa, huge thickness of submucosa and of entire stomach.

very small and contracted to barely one-third normal size; its wall markedly thickened throughout. Three centimeters proximal to the pylorus was a marked contraction and narrowing of the lumen to about 1.5 cm. There was no evidence of crater or ulcer on the peritoneal surface. The pylorus and duodenum were negative. There were no enlarged glands. It was thought that the condition was probably a linitis plastica but when the liver was found to be enlarged, quite mottled in appearance, and showing marked fibrosis with one nodule on its under surface 2 cm. in diameter, the luetic nature of both hepatic and gastric disease was suspected and partial gastrectomy was decided upon to relieve the antrum obstruction.

When this was attempted and resection made at a point well above the constriction, a huge thick stomach wall 1 to 1.5 cm. in thickness was encountered. An incision 3 cm. higher revealed the same condition. Finally, at a

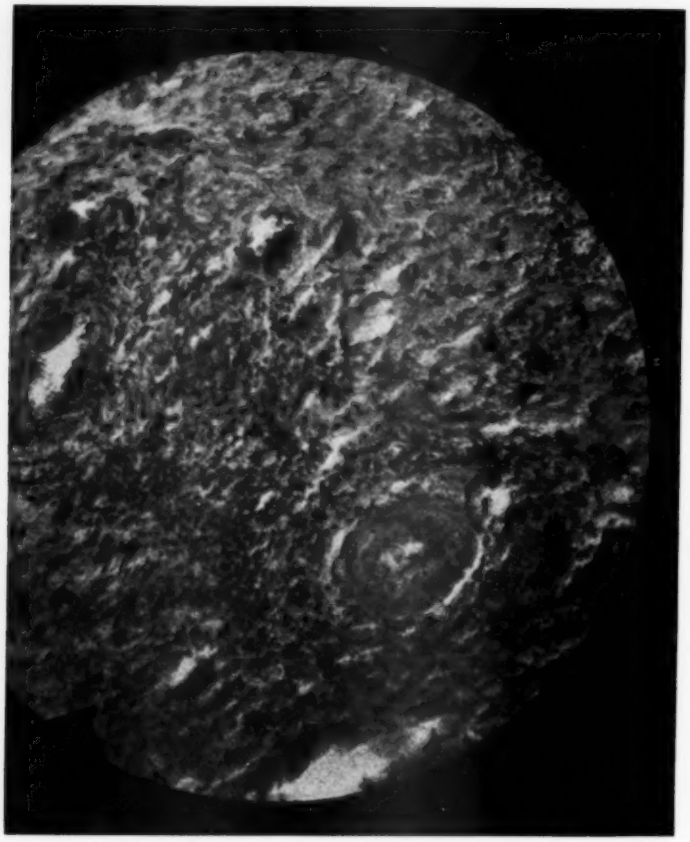

FIG. 3. Photomicrograph of submucosa, showing extensive round-cell infiltration, largely perivascular, and obliterating endarteritis.

point as high as possible, resecting fully two-thirds of the stomach, we found a similar thick firm stomach wall. As the patient's condition did not justify the formidable procedure of a *complete* gastrectomy it was decided to make the anastomosis between the stomach and jejunum through this diseased area, trusting that healing would occur under antiluetic treatment; the operation was completed as a posterior Polya-Balfour operation.

Pathological Examination: The resected portion of the stomach showed a very superficial serpiginous ulcer of the posterior wall and greater curvature at the point of narrowing, about 4 × 1.5 cm. Microscopically, the primary change in all layers was a small round-cell infiltration. These cells were for the most part plasma cells and lymphocytes with, however, a goodly

number of eosinophilic and neutrophilic polymorphonuclear leucocytes. Portions of the mucosa had been destroyed by an ulcerative process. The submucosa was greatly thickened. The round cell infiltration was perivas-

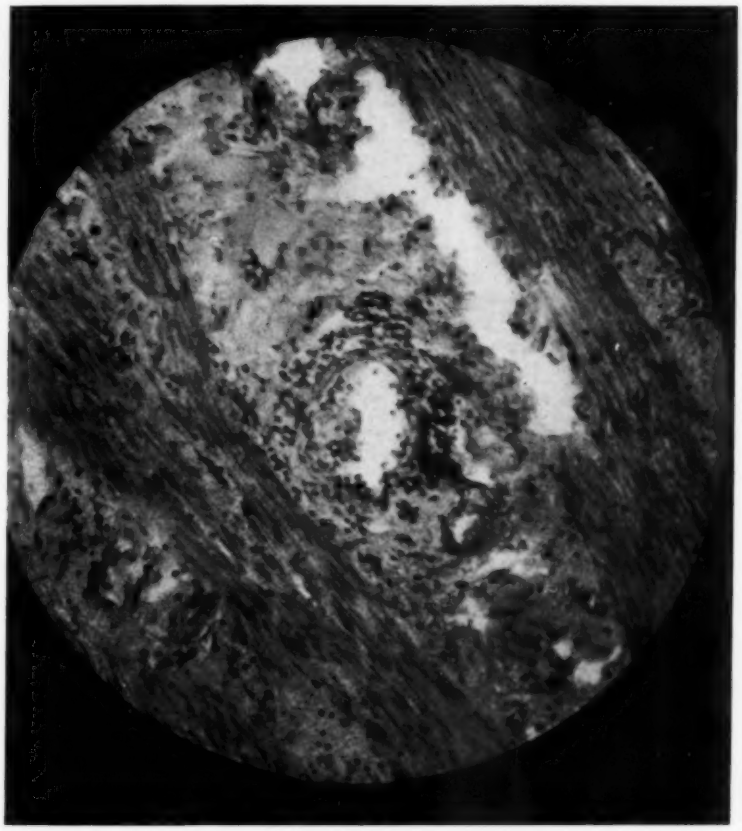

FIG. 4. Photomicrograph of muscularis showing again the perivascular round-cell infiltration with obliterating endarteritis.

cular in many areas and there was an obliterating endarteritis (Figs. 2–4). No giant cells were seen. Levaditi stain failed to reveal spirochetes.

Postoperative Course: Uneventful. Liquids were given in increasing amounts after forty-eight hours, a small amount of solid food on the eighth postoperative day. The Wassermann reaction following the operation was found to be ++++. Her husband admitted having had a chancre eighteen years before, but she denied all evidence or symptoms of venereal disease. She was finally discharged three weeks after the operation, eating and retaining small, frequent meals every three hours. She had no pain or vomiting, the wound was excellently healed, antiluetic treatment having been given for ten days.

Subsequent Course: Two to three days after leaving the hospital she again began to vomit solid food and belch gas. Within a week she was vomiting even liquids and three weeks after discharge she was readmitted

FIG. 5.

FIG. 6.

FIG. 5. Postoperative radiograph showing some of barium retained in remnant of stomach and only a trickle passing through stoma into jejunum.

FIG. 6. Final radiograph showing barium passing quite readily through gastrointestinal stoma three years after operation.

to the hospital, complaining of inability of food to pass into the stomach, a sensation of food sticking midway in the esophagus and prompt regurgitation of all food except liquids, if taken very slowly.

Examination on Readmission: A quite emaciated woman. Weight: 87 pounds. An old epigastric scar well healed but some deep thickening palpable beneath it. No distention or local tenderness.

X-ray showed no evidence of constriction or obstruction in the esophagus but barium was retained in the small remnant of the stomach, only a trickle going through the anastomosis (Fig. 5). Wassermann reaction: +++.

Course in Hospital: She improved under liquid diet, intensive antiluetic treatment and enemata and belladonna for about one week, but again began to vomit everything swallowed, even water. The constriction at the gastrojejunal anastomosis was evidently becoming worse and further operation seemed necessary.

Re-operation: Through a left rectus incision the upper abdomen was explored. The omentum was adherent to the old scar. A few coils of small intestine were also adherent about the gastrojejunal anastomosis which was indurated and thickened. The patient was in no condition to stand any

radical or extensive operation on the stomach. A jejunostomy by the Witzel technique was therefore made at a point 10 cm. to 15 cm. distal to the old anastomosis.

Postoperative Course: Excellent postoperative recovery. Feeding through the jejunostomy tube was begun within twenty-four hours. Slow but steady improvement. Only water, tea, and fruit juices given *by mouth*. These were retained. It had been felt that further gastric resection would eventually be required but antiluetic treatment was continued, and *x*-ray of the stomach three weeks after operation showed the old stoma quite patent, the barium dropping right through without any semblance of retention. Liquids and purees were then given by mouth and retained but semi-solid food would be occasionally regurgitated. She retained sufficient, however, so that supplemented by the jejunostomy feedings, she began to gain weight. Six weeks after the operation the idea of further surgery was abandoned and she was discharged. Her wound was well healed about the jejunostomy tube, and she was strong enough to walk about.

Subsequent Course: Intensive antiluetic treatment was carried out. The jejunostomy tube was allowed to remain for nine months, then removed, and the wound healed promptly within one week. There was no leakage. Semi-solid and finally small solid meals have been taken.

Follow-up Report: Three years after the operation her Wassermann reaction is still ++. The wounds are excellently healed. After chewing well she can eat almost any food, but in four or five small meals. Radiograph now shows a mere scar or shell of the stomach remnant left. Barium, after being swallowed, falls from the esophagus directly into the jejunum (Fig. 6). She has gained 25 pounds in weight, can do her housework as well as ever, and feels completely relieved. She is still under treatment for syphilis.

Comment: A woman of thirty-eight with a linitis plastica type of syphilis of the stomach, with obstruction near the pylorus, developed after partial gastrectomy through unhealthy tissue, stenosis of the stoma, which cleared up after a jejunostomy and intensive antiluetic treatment, and went on to complete recovery without further operation. A linitis plastica type *with actual obstruction* is of interest, as it is unusual. From her symptoms both before and after resection esophageal stricture was at first suspected but no lesion of the esophagus was ever demonstrated. A slight cardiospasm was present but the real stenosis was in the antrum and at the anastomosis. Complete gastrectomy would have been

required to remove all the diseased tissue, as the entire stomach was involved, but her condition at the primary operation did not justify so extensive a procedure and partial gastrectomy was decided upon as likely to be sufficient if antisyphilitic treatment could heal the gastric remnant permitted to remain. The subsequent course indicated at first that further resection would be necessary, but a jejunostomy proved to be sufficient with continued antiluetic treatment to overcome the stenosis and permit final healing.

Graham[8] has shown that resection is preferable in the surgical treatment of gastric syphilis; a review of 34 reported operations indicated that pylorectomy is more likely to be followed by complete relief of symptoms than is simple gastroenterostomy.

CONCLUSIONS

1. A brief review of the present status of syphilis of the stomach has been given and a report of a case of the linitis plastica type confirmed by histological examination of the resected specimen.

2. It is suggested that jejunostomy for feeding may help solve the surgical problems of this disease as in other extensive gastric lesions.

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ADYNAMIC ILEUS*

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OF the various types of ileus, the adynamic variety is the most difficult to recognize promptly and treat successfully. Adynamic ileus, in contrast to mechanical obstruction of the bowel, has no mechanical hindrance to the passage of the fecal stream, but as a result of interference with the nerve supply to the gut or of changes in the gut wall itself, the normal intestinal movement is inhibited. Objections to the terms "adynamic" or "paralytic" as applied to this type of ileus have been made by Mueller,[1] and Alvarez and Hosoi,[2] because they have shown that in animals with experimentally produced adynamic ileus there exists no paralysis of the gut musculature. Alvarez and Hosoi[2] have demonstrated that in adynamic ileus there occurs a leveling of the intestinal gradients and they suggest "flat-gradient" as an appropriate term.

The causes of adynamic ileus are even more varied than those of mechanical ileus. They may be classified as follows:

1. Intra-abdominal
    - A. Peritoneal irritation
        1. Traumatic
            - a. Postoperative
            - b. Penetrating wounds
        2. Bacterial
            - a. Peritonitis
        3. Chemical
            - a. Extravasation of blood
            - b. Perforated peptic ulcer } Early
            - c. Bile peritonitis } Early
            - d. Acute pancreatitis } Early

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B. Vascular changes
1. Strangulation
a. Intramural
Distention following mechanical ileus
b. Extramural
Compression of the mesenteric vessels
2. Mesenteric thrombosis
C. Extraperitoneal irritation
1. Hemorrhage
2. Infection
3. Renal
II. Extra-abdominal
A. Toxic
1. Pneumonia
2. Uremia
3. Empyema
4. Systemic infection
B. Neurogenic
1. Injuries and diseases of the spinal cord
2. Lead poisoning
3. Fracture of the lower ribs
Irritation of the splanchnic nerves

Undoubtedly the most frequent cause of adynamic ileus is the trauma and exposure to air of the intestine which occur during a laparotomy; in fact, every patient who has had a celiotomy has, for varying periods of time, postoperatively (usually from six to twenty-four hours) a functional inactivity of the gastrointestinal tract which may be termed a *physiologic* ileus. The recognition of this type of ileus is imperative, because the forcing of food and fluids by mouth in such an individual is not only undesirable, but even detrimental. The adynamic ileus which almost invariably is associated with peritonitis may also be termed a physiologic ileus in that it is protective and probably tends to prevent dissemination of the infection within the peritoneal cavity. Another frequent cause of adynamic ileus is that which usually follows a neglected case of

mechanical ileus. This is probably due to an interference with the blood supply to the musculature of the gut resulting from prolonged distention of loops of bowel with intramural compression of the vessels. This intramural strangulation produced by distention of the intestine has been demonstrated experimentally by Van Zwalenburg[3] and others.[4–8]

The mechanism by which vascular changes either within the wall of the gut or within the mesentery produces adynamic ileus differs from that which results from peritoneal irritation, toxic or neurogenic causes in that in the former, changes occur primarily in the gut musculature, whereas in the latter there is a hyperstimulation of the splanchnic nerves.

Hotz[9] and Arai[10] demonstrated experimentally that the adynamic ileus in peritonitis could be prevented by the division of the splanchnic nerves. That stimulation of the splanchnic nerves inhibits intestinal activity has been demonstrated experimentally by a number of investigators.[9,11–14]

PATHOLOGY

As a result of increasing distention of the bowel, intestinal secretion becomes markedly increased,[1,7,15] and absorption from the gut concomitantly decreased.[16–18] The bowel becomes laden with large quantities of toxic fluid. This tends to produce a vicious circle in that as a result of the increased intra-intestinal contents and pressure the blood vessels within the intestinal wall are compressed, which in turn aggravates the adynamic ileus. Zuntz and Tacke[19] and Usadel[20] have shown that the normal absorption of gases from the intestinal tract is inhibited in ileus. McIver and his associates[21] have demonstrated that if a loop of intestine is distended, carbon dioxide passes from the blood into the intestinal lumen. As a result of the increased intra-intestinal pressure and the early compression of the venous return from the bowel, there occurs within the wall of the intestine edema, and even infarction on the antimesenteric border. Mueller[1] has found in animals with

adynamic ileus that the muscle cells of the intestine become hydropic, elongated, enlarged and swollen.

SYMPTOMS AND SIGNS

The symptoms and signs of adynamic ileus are differentiated from those of mechanical ileus by the absence of recurrent colicky pains which characteristically accompany the latter. The pain, if present in adynamic ileus, is more apt to be continuous, of a dull, aching or boring character. The patient may or may not appear ill. Depending upon the extent of involvement, there result varying degrees of abdominal distention. The patient is frequently nauseated and usually vomits. Vomiting may be intermittent or even almost continuous. Mueller[1] believes that as a result of the ileus there occurs a relaxation of the pyloric sphincter, which allows an abnormal regurgitation of the intestinal contents into the stomach. As shown by Alvarez and Hosoi,[2] there is a lack of normal caudad propulsion of intestinal contents; in fact, there may be an actual reversal of peristalsis. This fact is well known clinically and is the only way in which fecal vomiting can be explained.

Auscultation of the abdomen should never be neglected because in adynamic ileus there is an absence of peristalsis and peristaltic sounds ("silent abdomen"), in contradistinction to mechanical ileus in which the peristaltic sounds are increased. Prior to complete cessation of all intestinal movement a metallic tinkle is usually audible.[22,23] It is the result of movement of the contained gas and fluid in the dilated loops of bowel. Abdominal tenderness, if present, is due to peritoneal irritation and not to the ileus *per se*.

Of great value in the diagnosis of any type of ileus is the roentgenographic determination of dilated loops of intestine filled with gas and fluid (Fig. 1). This procedure, which was first used by Schwartz[24] in 1911, has become a valuable diagnostic aid in the detection of ileus. Positive roentgenographic findings in adynamic ileus have been observed by many investigators.[25–29] That it occurs early in the course of

the condition is to be expected from the investigations of Ochsner,[30] who found that in the presence of strangulation (which is present to a certain extent in all cases of adynamic

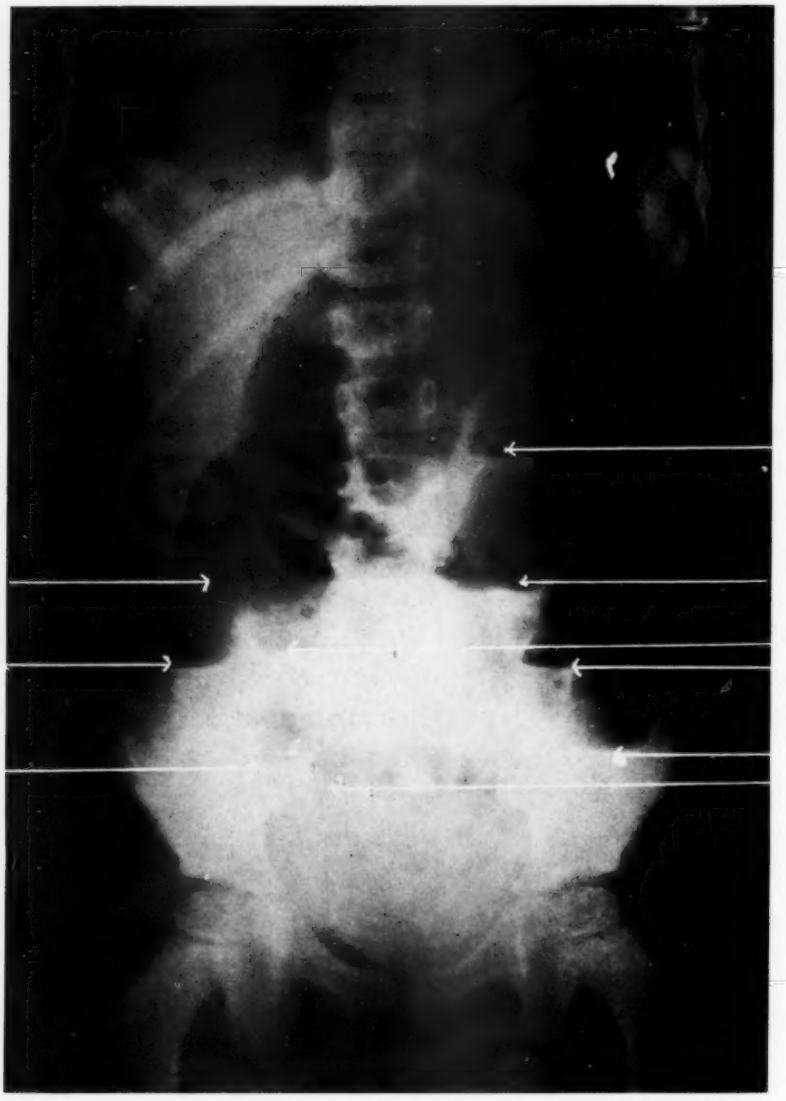

FIG. 1. Plain roentgenograms of abdomen of a patient taken in upright position, showing multiple fluid levels, as indicated by arrows.

ileus), the accumulation of gas and fluid occurred earlier and was more marked than in obstructions in which there was no interference to the blood supply of the gut (Fig. 2).

Because of the difference in therapeutic indications it is imperative to differentiate the postoperative adynamic ileus from the postoperative mechanical obstruction. As a rule an

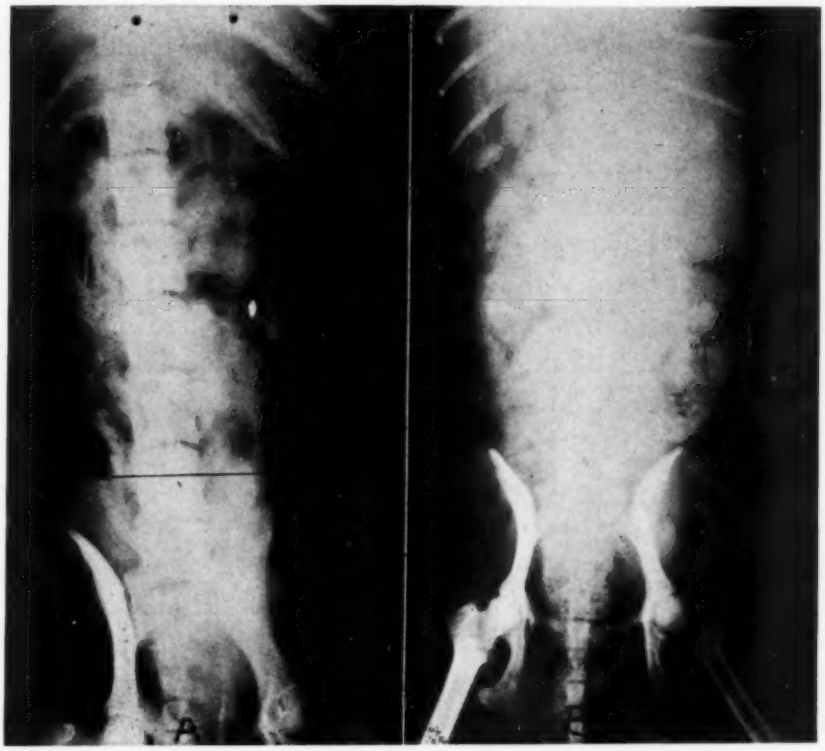

FIG. 2. Plain roentgenograms of abdomens of experimental animals. Roentgenogram A is of an animal with a seven hour old strangulated obstruction of ileum. As indicated by arrows, there are multiple fluid levels in addition to considerable accumulation of gas. Roentgenogram B is of an animal with a seven hour old simple obstruction of ileum. There is some gas accumulation, but no evidence of fluid.

ileus developing within the first twenty-four to forty-eight hours postoperative is of the adynamic variety, whereas that developing several days after a laparotomy is usually of the mechanical type. When associated with peritonitis, however, it may be either adynamic or mechanical. This practical differentiation between those cases of ileus which occur early or late after an operation is often of immense value.

TREATMENT

There is probably no condition in which prophylaxis is more important than in adynamic ileus. It is a well-known fact that within recent years, as a result of the almost routine abandonment of drastic preoperative catharsis, there has been a decreased incidence of postoperative distention, gas pains, and adynamic ileus. In those cases in which thorough emptying of the bowel is desirable preoperatively, such as colon cases, catharsis may be used a number of days before operation, following which the patient is placed on a non-residue diet. Ordinarily, catharsis should be omitted in all cases and an evacuation of the lower bowel be secured by the preoperative administration of bland enemas. In this way any irritation of the bowel is prevented and the postoperative convalescence, by decreasing the incidence of physiologic ileus, is made much smoother. Of even greater importance in the prophylactic treatment of adynamic ileus is the gentleness in handling intra-abdominal viscera during operation. Whereas there appear to be individual variations in responses to trauma, *generally the degree of adynamic ileus following an operation is directly proportional to the intraperitoneal trauma and manipulation.* Sharp dissection should, whenever possible, be used. Careful hemostasis is imperative, because residual blood in the peritoneal cavity causes peritoneal irritation which favors the development of an adynamic ileus. Obviously, contamination of the peritoneal cavity is to be prevented as the irritation associated with peritonitis is a frequent and not unimportant cause of adynamic ileus. Meticulous technique is necessary in operations upon hollow viscera, especially the gastrointestinal tract. If the afore-suggested measures are adhered to, the incidence of adynamic ileus will be markedly decreased and the convalescence of the patient greatly favored.

In considering the treatment of adynamic ileus, once the condition has developed, it is desirable to divide the cases of ileus into two large groups: (1) those in which the adynamic

ileus is mild or of the physiologic type, and (2) those in which the adynamic ileus is severe. As most patients who have had an abdominal section develop physiologic ileus, the measures which are advocated for the treatment of the mild cases of adynamic ileus should be used routinely postoperatively. In the cases of the severe types of adynamic ileus, the simpler measures should also be continued, but in addition it is necessary that other forms of therapy be resorted to. As the gastrointestinal tract is functionally inactive in all cases of adynamic ileus, it is imperative that these patients receive nothing by mouth at least until all nausea ceases. We are convinced from our own clinical experience that the routine administration of fluids by mouth as soon as the patient has recovered from the anesthetic cannot be too strongly condemned. If nothing, not even water, is administered by mouth until all nausea has ceased a smoother convalescence will be insured. Robb[31] is of the opinion that patients with adynamic ileus should not only receive nothing by mouth but also should not be given proctoclyses. As soon as all nausea has ceased (usually six to eight hours postoperative), small sips of hot water will probably be tolerated. We agree with Alvarez and Hosoi[2] that once nausea has subsided the feeding of the patient is frequently the greatest stimulus to intestinal activity. In our hands the administration of a fat-free broth is a valuable aid in stimulating peristalsis. The application of heat to the abdomen in the form of an electric light tent has been the most efficacious way of combating postoperative distention and relieving gas pains. We feel that it is extremely valuable in the early treatment of mild cases and in the prevention of severe cases of adynamic ileus. It is our routine to apply an electric light heat tent to the abdomen immediately upon the patient's return from the operating room. This is maintained continuously until normal gastrointestinal activity has been reestablished. Application of heat to the abdomen has been used and advocated by a number of surgeons.[23,32–36] Mueller[1] has shown that the application of heat to the abdomen by increasing the peripheral circulation

decreases the splanchnic blood supply, which he believes in turn favors intestinal peristalsis and decreases intestinal secretion.

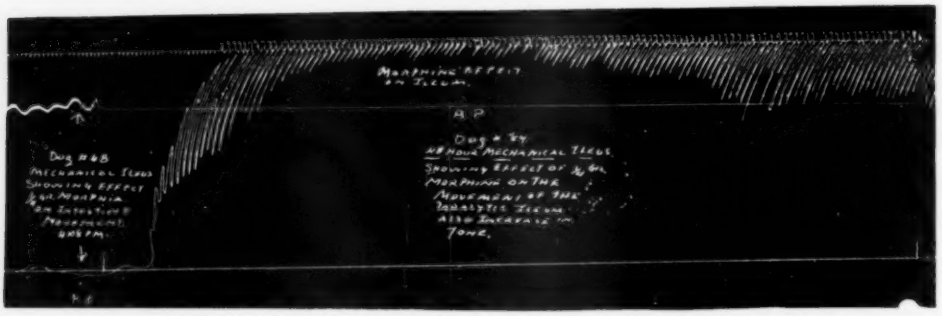

FIG. 3. Kymographic tracing showing effect of subcutaneous injection of morphine, grs. ¼, on intestine of an animal with an adynamic ileus superimposed upon a mechanical obstruction. Shortly after administration of morphine, as indicated by arrow at right hand side of tracing, there was a marked rise in intestinal tone associated with an increase in intestinal movement. This persisted throughout experiment.

Contrary to the idea generally accepted by clinicians that morphine favors an ileus by producing constipation, we have found experimentally and also clinically that the postoperative administration of morphine not only is of value because of its analgesic effect, but also is actually of value in preventing adynamic ileus. Our experiments[37] with adynamic ileus superimposed upon a mechanical obstruction showed that the administration of morphine caused an actual increase in intestinal motility in 93 per cent of the observations and that in none was there a decrease in activity (Fig. 3). Similar results with normal[38–45] and obstructed[45,46] intestine have been obtained by a number of investigators. Clinically we have been able to show graphically (Fig. 4) and by auscultation that the subcutaneous administration of morphine increases intestinal activity in patients. We feel, therefore, that morphine should not be spared; in fact, on the contrary, we believe that it is a valuable drug in the prevention and treatment of adynamic ileus. Postoperatively and in all mild cases of adynamic ileus, it is important to restore water balance by the administration of normal saline subcutaneously or tap water by rectum.

Dextrose solutions are seldom indicated, but when indicated, preferably should be given subcutaneously. If dextrose solutions are used intravenously, it is imperative that sufficient

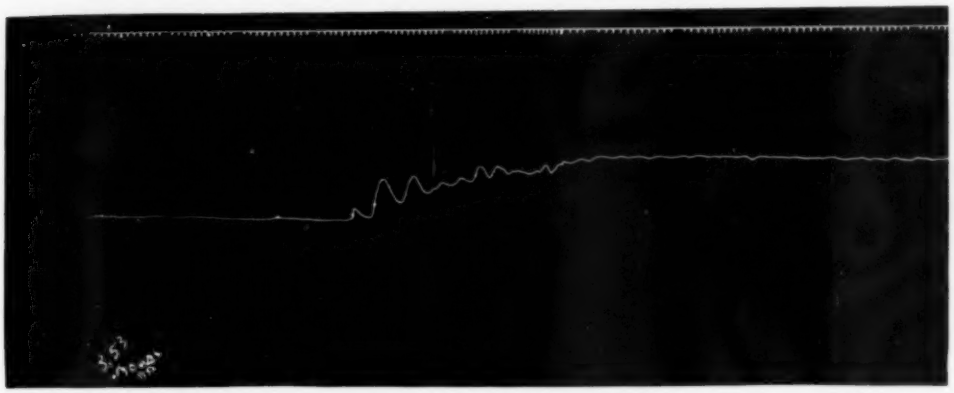

FIG. 4. Kymographic tracing showing effect of subcutaneous injection of morphine, grs. ¼, on motility of human large intestine. Approximately three minutes after injection of morphine there was a definite increase in tone and an increase in gut activity. After approximately four minutes, during which time tone increased, intestinal movement became stationary, but tone remained elevated.

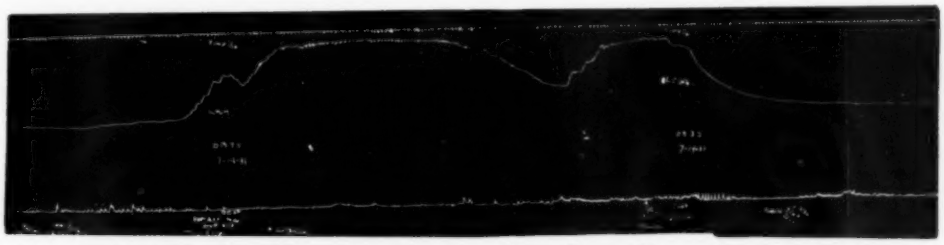

FIG. 5. Kymographic tracing showing depressing effect of intravenous administration of dextrose on motility of gut. At left of tracing inactive gut is activated by intravenous administration of a "hypertonic" Hartmann's solution. Following this there was a marked increase in intestinal tone associated with increased intestinal movement. At approximately junction of right and middle thirds of tracing, at height of increased intestinal activity, an intravenous infusion of 10 per cent glucose was started. Within a minute and a half after beginning of infusion there was complete cessation of all intestinal movement and a rapid fall in tone to its original level.

insulin be administered to metabolize the dextrose, because we have shown experimentally that the intravenous administration of dextrose alone exerts an inhibiting effect on the intestinal activity (Fig. 5), whereas if the dextrose is fortified with insulin, this inhibiting effect is not so marked; in fact, it is

actually lost (Fig. 6). All patients who are nauseated should be given the advantage of a gastric lavage. If the nausea persists or if vomiting is present, an intragastric and even trans-

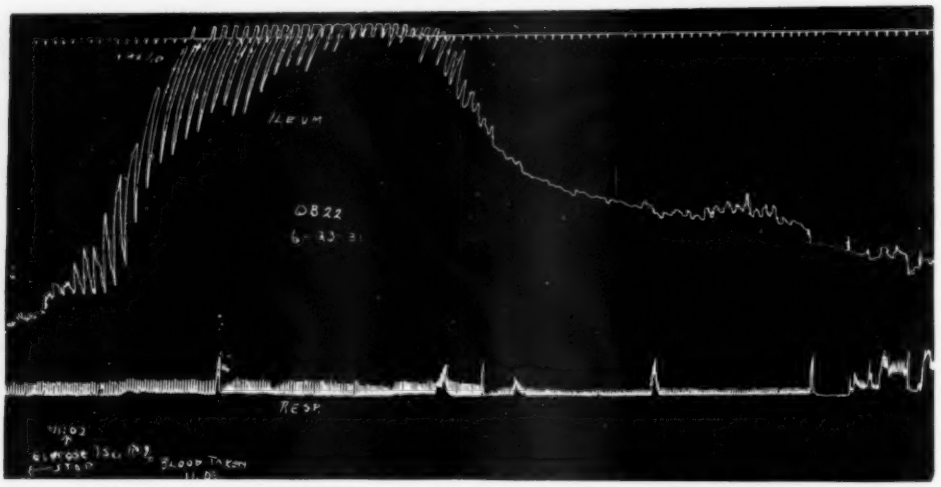

FIG. 6. Kymographic tracing showing effect on activity of intestine of intravenous administration of glucose, following a previous injection of insulin. As shown at left hand side of tracing, immediately after completion of an infusion of 75 c.c. of 10 per cent dextrose solution, there was a rapid rise in intestinal tone and an increase in intestinal movement. This markedly increased intestinal activity persisted approximately three minutes, following which there was a fall in tone, level, however, never reaching that which it was before administration of dextrose solution. Insulin injected preceded dextrose injection by twenty minutes.

duodenal decompression should be done by means of an indwelling duodenal catheter, which can easily be introduced through the nares. In this way not only will the retained and regurgitated contents from the upper intestinal tract be evacuated, but also the increased intragastric and intraintestinal pressures will be relieved. This tends to break the vicious circle by preventing the intramural interference with the blood supply to the gut. Transduodenal decompression is especially important in the severe cases of adynamic ileus and must be used continuously. Duodenal drainage in ileus by an indwelling nasal catheter was first used by Westerman[48] and its value as a decompressive agent of the upper gastrointestinal tract has been emphasized by many investigators.[49–54]

TREATMENT OF SEVERE CASES OF ADYNAMIC ILEUS

All cases of severe adynamic ileus should receive the same treatment as advocated above for physiologic or mild cases, but in addition other measures are necessary. As originally shown by Haden and Orr[55] and subsequently corroborated by many other observers, patients with ileus usually suffer from a hypochloremia and an associated alkalosis. In order to combat the hypochloremia and its concomitant changes, it is necessary that patients with adynamic ileus be administered chlorides, principally in the form of physiologic sodium chloride solution. This remineralization of the patient is especially indicated in those individuals in whom there is a considerable loss of gastric and upper intestinal secretions. The replacement of chlorides can easily be accomplished by the administration of normal or hypertonic solutions of sodium chloride. Hughson and Scarff[56] in 1924 demonstrated experimentally that the intravenous administration of a hypertonic solution of sodium chloride, in addition to replacing the chloride loss, actually increased the intestinal activity. This procedure has been used subsequently by many observers.[57–74] We[75] have shown experimentally and believe to have been able to corroborate the fact clinically that the intravenous administration of solutions containing calcium and potassium chloride is more efficacious in stimulating gut activity than are solutions containing sodium chloride alone. (Fig. 7.) We[75] found experimentally in comparable groups of animals with adynamic ileus superimposed upon a mechanical ileus that the intravenous administration of sodium chloride in average doses of 8.4 c.c. per kilogram of body weight produced an increase in the intestinal activity in 90.4 per cent, a decrease in 4.7 per cent, and no change in 4 per cent of the observations. The average increases in tone and amplitude were 28.6 mm. and 5.05 mm., respectively. The average duration of the increased activity was eleven minutes. In a similar series of animals in which a "hypertonic" Ringer's solution, the normal constituents of which had been multiplied by twenty,

was given intravenously the following results were obtained: in 98 per cent of the observations there was an increase in intestinal activity, in none was there a decrease, and in only

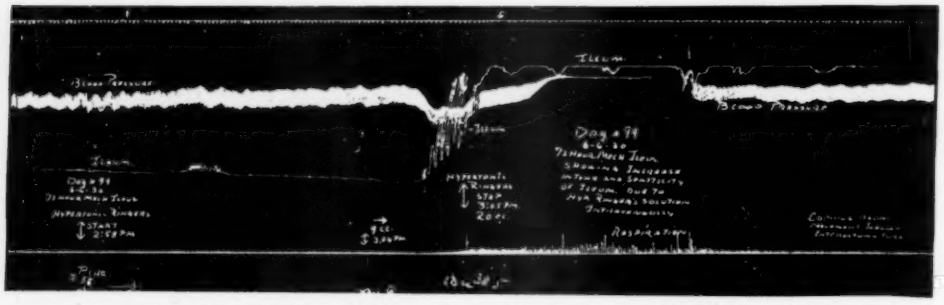

FIG. 7. Kymographic tracing showing stimulating effect on intestine of intravenous administration of a "hypertonic" Ringer's solution. At approximately midportion of tracing after administration of 20 c.c. of "hypertonic" Ringer's solution there was a rapid rise in intestinal tone associated with increased intestinal movement, which persisted.

2 per cent of the observations was the activity unchanged. The average increases in tone and amplitude were 63.8 mm. and 16.07 mm., respectively. The average duration of the increased activity was eighteen minutes. The average dose of the "hypertonic" Ringer's solution was 2.5 c.c. per kilogram of body weight.

Recently we have used modified Ringer's solution as advocated by Hartmann.[76] This solution contains in addition to the sodium, potassium and calcium chloride, sodium lactate which acts as an excellent buffer and which is readily oxidized. We have used "hypertonic" Hartmann's solution prepared in the following manner: to the contents of a 20 c.c. ampoule of the Hartmann's solution are added 5 c.c. of distilled water, giving a solution of sodium chloride, 11.7 per cent; potassium chloride, 0.74 per cent; calcium chloride, 0.54 per cent; and sodium lactate, 5.6 per cent. This "hypertonic" Hartmann's solution is twenty times the strength of the physiologic solution. We have obtained experimentally equally good results with the use of the intravenous administration of "hypertonic" Hartmann's solution as we did with the "hypertonic" Ringer's solution; in fact, the character of the response

was such that there were slightly greater increases in intestinal tone and amplitude of intestinal movement following the administration of the former than the latter (Figs. 5 and 8).

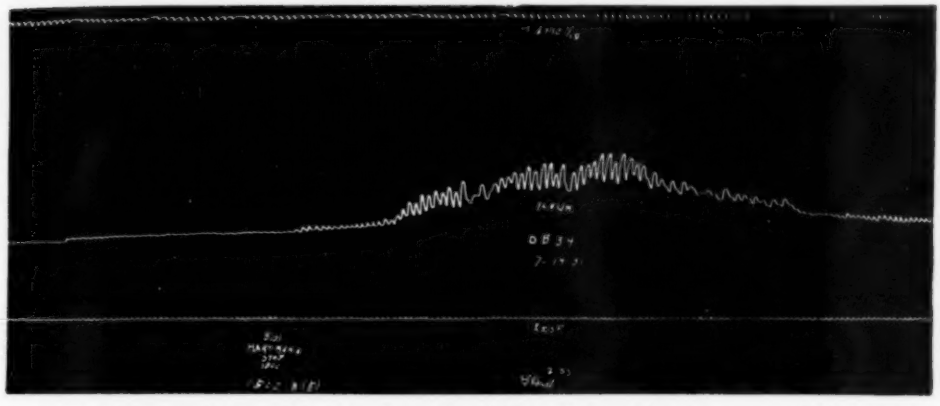

FIG. 8. Kymographic tracing showing stimulating effect of intravenous administration of a "hypertonic" Hartmann's solution on adynamic intestine. At approximately junction of left with middle third of tracing following intravenous administration of 15 c.c. of Hartmann's solution there was a definite increase in intestinal tone and activity of intestinal movement.

Because of the ease with which "hypertonic" Hartmann's solution may be prepared, we have employed it almost routinely in our clinic. The following are characteristic clinical examples:

CASE I. M. R., colored male, aged thirty-three, admitted to the Charity Hospital October 24, 1932. On October 23 the patient was stabbed in the lower left thorax. On admission to the hospital his abdomen was distended, which condition persisted. October 25: Abdominal distention much worse, producing respiratory embarrassment. October 26: 15 c.c. of "hypertonic " Hartmann's solution given intravenously at 12:00 noon. Between 1:00 and 7:00 P.M. the patient had several large evacuations and passed considerable flatus. Patient was considerably relieved. October 27: There was still some slight distention of the abdomen. From this time on the patient's bowels moved spontaneously until he was discharged on November 10. A diagnosis of paralytic ileus was made in this case and it was thought that the ileus was probably due to stimulation of the splanchnic nerves in the retropleural space.

CASE II. J. R., white male, aged thirty-two, admitted to Charity Hospital on October 11, 1932. On October 19 a cholecystectomy and appendectomy were performed. October 20: Marked distention of the

abdomen associated with hiccoughing. Gastric lavage performed without relief. Patient given 1000 c.c. of 10 per cent glucose intravenously. Following an enema there was some slight relief in symptoms, but the abdominal distention was unaffected. October 21: Hiccoughing still present. Distention even greater. Enemas failed to relieve distention. 9:15 P.M., 15 c.c. "hypertonic" Hartmann's solutions given intravenously. 9:30 P.M., considerable gas and a small amount of fecal material evacuated through the rectal tube. This relieved the abdominal distention. From this time until October 26 patient received repeated intravenous infusions of 10 per cent dextrose, unfortified by insulin. The abdominal distention persisted. October 26: 15 c.c. of "hypertonic" Hartmann's solution intravenously, which resulted in the expulsion of considerable gas and a large amount of fecal material. Fecal evacuation and passage of flatus continued throughout the night. Patient made an uneventful recovery following this and had no further abdominal distention.

CASE III. S. B., white female, aged thirty-two, admitted to the Charity Hospital October 27, 1932. Hysterectomy and appendectomy. October 29: Abdomen distended. Purgative enema given with no results. October 30: Abdominal distention increasing unaffected by gastric lavage. 7:20 P.M., 10 c.c. of "hypertonic" Hartmann's solution given intravenously, 8:00 P.M., considerable gas and a large quantity of feces expelled through the rectal tube. 9:30 P.M., rectal tube still discharging feces. Throughout the night the discharge from the rectal tube continued to be profuse. October 31: Abdominal distention reappeared. 11:30 A.M., 15 c.c. of "hypertonic" Hartmann's solution given intravenously. 12:00 noon considerable gas and large amounts of intestinal contents expelled. 1:00 P.M. still further evacuation of feces. Patient complained of abdominal colic. 4:00 P.M. abdominal distention completely relieved, following which the patient made an uneventful recovery.

CASE IV. E. H., white male, aged sixty, admitted to Charity Hospital June 6, 1932. Diagnosis: Complete luetic stricture of rectum. September 28: sigmoidostomy. November 1: Balloon introduced through sigmoidostomy wound into the descending colon. Kymographic tracing of gut movement. Normal peristaltic sounds. Twelve and a half cubic centimeters "hypertonic" Hartmann's solution given intravenously. Within twenty minutes after the beginning of the infusion there were definite increases in tone and movement of the gut (Fig. 9). Peristaltic sounds were increased.

In those cases in which transduodenal drainage has failed to decompress the intestine and in which adynamic ileus persists because of intramural strangulation caused by marked intestinal distention, further decompression is imperative.

This can be accomplished by either single or multiple enterostomies. Frequently a single enterostomy will fail to accomplish the necessary decompression and because in adynamic

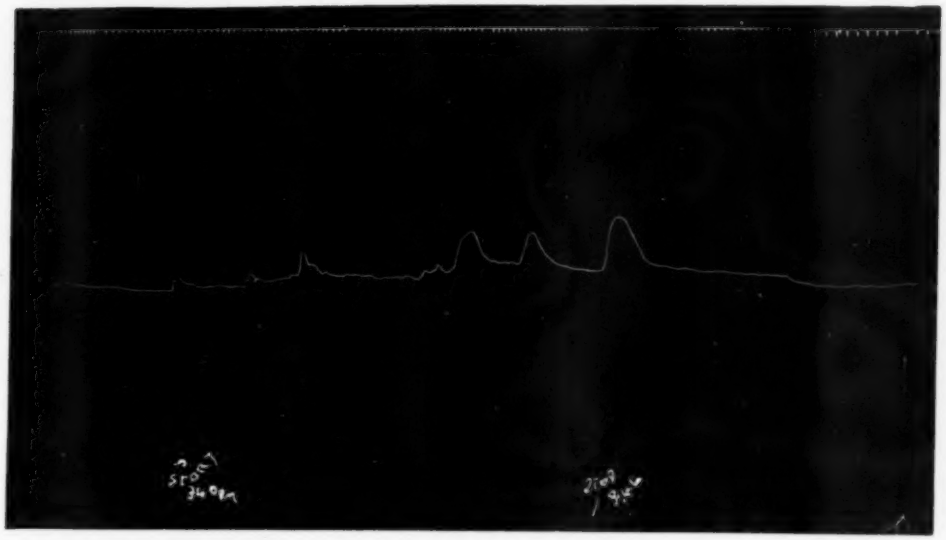

FIG. 9. Kymographic tracing showing stimulating effect of intravenous administration of "hypertonic" Hartmann's solution on normal large intestine of human. At left of tracing, within a minute of beginning of infusion, there was an increase in intestinal tone, which was associated with large excursions of intestinal movement.

ileus the propulsive power of the gut is lost, the decompression is limited to that particular loop of the gut drained by the enterostomy. This frequently explains the failure to obtain relief by enterostomy in adynamic ileus. In this type of case satisfactory decompression can be obtained only by several enterostomies.

As demonstrated by the experimental work of Walters, Kilgore and Bollman,[77] and Morton and Pearse,[78] the clinical picture of "high" intestinal fistula is very similar to that of "high" intestinal obstruction and the blood chemistry changes are comparable. This is undoubtedly due to the fact that the electrolytes of the body are lost, in the one case through the fistulous opening and in the other case in the vomitus.

First advocated by Lennander[79] in 1907, enterostomy has been employed by a number of surgeons.[80–89] It must be

remembered, however, that an enterostomy is not a panacea and that the most that can be expected of it in cases of adynamic ileus is decompression of the bowel, which will in

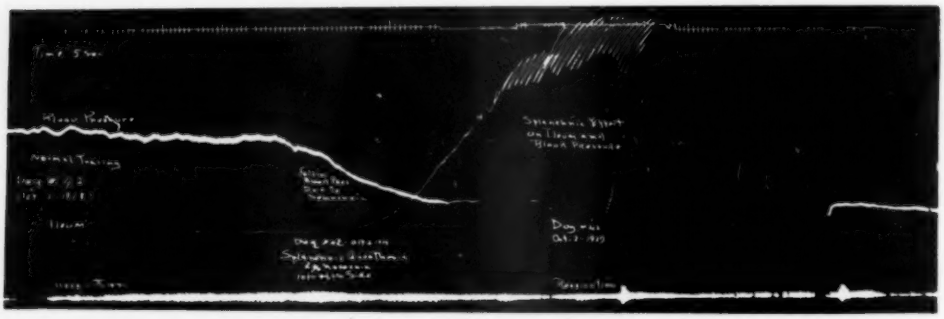

FIG. 10. Kymographic tracing showing stimulating effect of a splanchnic analgesia on a paralytic gut following mechanical obstruction. At approximately junction of right and middle thirds of tracing a splanchnic analgesia was performed. Almost immediately there was a fall in blood pressure and a marked rise in intestinal tone and increase in intestinal movement.

turn prevent interference with the blood supply to the gut musculature and thus favor the return of intestinal movement. It should also be emphasized that enterostomy, even though probably of value in the late cases, preferably should be used after the simple measures already outlined have failed, because following prolonged and marked distention of the intestine all decompressive procedures may be of no value in reestablishing intestinal movement.

In those cases in which the adynamic ileus is due to an overstimulation of the splanchnic nerves, resulting in an inhibition of the intestinal activity, some type of splanchnic block is of distinct therapeutic value. In fact, the splanchnic block produced by spinal analgesia has been advocated by W. J. Mayo[90] and Williard Bartlett, Jr.[91] as a diagnostic procedure differentiating between a mechanical and an adynamic ileus. We, however, believe that such a procedure is not a reliable diagnostic aid, because as shown by Duval's[92] statistics in which an evacuation of the intestines was produced in 16 per cent of cases with mechanical ileus, one is apt to overlook those cases of mechanical ileus which respond to splanchnic block.

In an experimental investigation we[93] found that splanchnic analgesia, performed by introducing an anesthetic solution in the retroperitoneal space by the posterior route according to

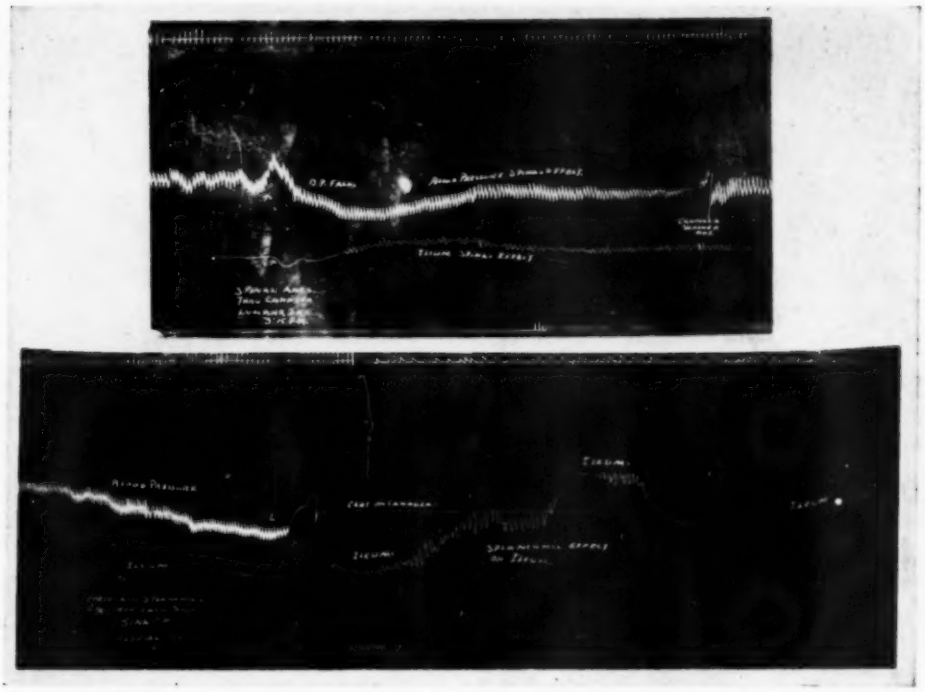

FIG. 11. Kymographic tracing showing relative effects of spinal and splanchnic analgesia on intestinal movement. As shown in upper tracing, following a splanchnic analgesia there was a slight fall in blood pressure and a slight rise in intestinal tone associated with an increase in intestinal movement. As shown in lower tracing, following a splanchnic analgesia there was a similar fall in blood pressure, but a much more marked increase in intestinal tone and intestinal movement.

the technique of Kappis,[94] was efficacious in overcoming an adynamic ileus following a mechanical obstruction (Fig. 10). The splanchnic analgesia in every instance produced an increase in intestinal tone. The average increases in tone and amplitude were 29.5 mm. and 11.2 mm., respectively. There was an average blood pressure decrease of 20 mm. of mercury. Following a spinal analgesia in a similar series of experiments, it was found that the effect on the intestinal tone and motility was less prolonged and the effect on the blood pressure more

marked than that obtained following a splanchnic analgesia (Fig. 11). We believe, therefore, from our experimental and also from our clinical results that if a splanchnic block is to be

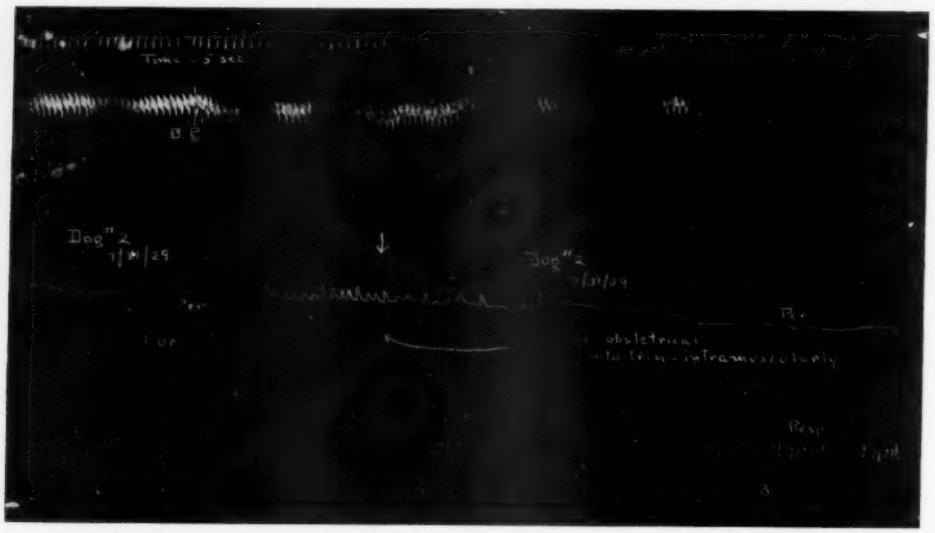

FIG. 12. Kymographic tracing showing depressing effect on intestinal movement of intramuscular injection of pituitrin. At approximately the midportion of the tracing, 2 c.c. of obstetrical pituitrin were given intramuscularly. Following this there was a fall in intestinal tone and a complete cessation of all intestinal movement.

performed a splanchnic analgesia according to the technique of Kappis[94] is preferable to a spinal analgesia. If a splanchnic block, either as a spinal analgesia or splanchnic analgesia, is done, it is important that the usually employed blood pressure raising drugs; viz., ephedrine and adrenalin, be omitted, because these substances stimulate the myoneural junction of the sympathetic system distal to the point of block and the desired results would be nullified. We[93] have been able to show experimentally that such actually occurs. This undoubtedly explains the relaxation and inactivity of the intestine characteristically seen during laparotomies performed under spinal analgesia in which ephedrine has been used to prevent fall in blood pressure. In the days before ephedrine administration hyperactivity of the intestinal tract generally occurred.

A large number of drugs have been used clinically in an attempt to stimulate the motor activity of the intestine in adynamic ileus. Of the various drugs, the most frequently employed and apparently those which have obtained the greatest approbation are extracts of the pituitary gland. It has been our clinical experience that even though pituitary extract at times may exert a very definite effect on the intestinal tract, in by far the majority of instances it is ineffectual. We[95] have also shown experimentally that pituitary extract produced an actual decrease in intestinal activity in 75 per cent of the observations on animals with adynamic ileus (Fig. 12). It may appear that our experimental results obtained with pituitrin are not applicable to the clinic, because of the occasional brilliant clinical results which have been obtained by the use of this substance. We feel, however, that pituitrin has its most marked action on the large bowel and that in those cases in which rapid and apparent complete evacuation occurs following the administration of pituitary extract the action has been largely on the colon. As, however, in the majority of instances adynamic ileus affects primarily not the large bowel, but rather the small bowel, we are of the opinion that pituitrin is of little or no value in the treatment of adynamic ileus. This conclusion is based upon the clinical experience that pituitrin has repeatedly failed to relieve abdominal distention, whereas relief has been obtained in these same cases by the intravenous administration of "hypertonic" Hartmann's solution. We[95] also investigated the effects of choline, acetyl choline, pitocin, peristaltin, and physostigmine on normal and obstructed intestine and found that of this group of drugs physostigmine was the only one which gave positive results in a sufficient number of cases to consider it of value clinically. In 55 per cent of the observations there was an increase in intestinal activity (Fig. 13), in approximately 25 per cent there was a decrease, and in approximately 20 per cent the activity was unchanged by the administration of $\frac{1}{50}$ grain of physostigmine subcutaneously. Clinically we have found that the subcutaneous administra-

tion of 1/50 grain of physostigmine has often been of great value in the treatment of adynamic ileus. We feel, however, that the other measures mentioned, viz., intravenous administration of

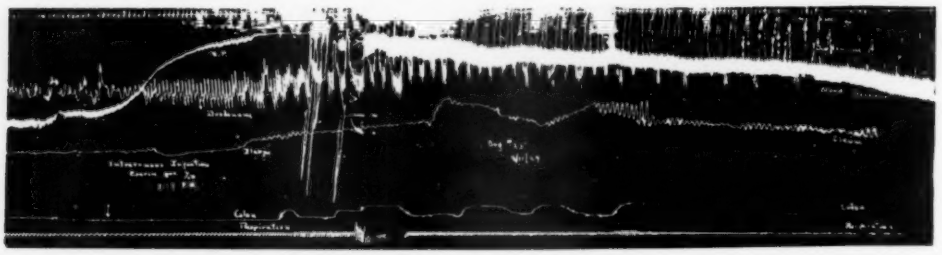

FIG. 13. Kymographic tracing showing stimulating effect of intestinal movement of injection of eserine. Movement of ileum is third tracing from bottom. At left of tracing, as indicated by arrow, 1/50 gr. of eserine was injected. Approximately two minutes after injection there was a gradual rise in intestinal tone associated with a definite increase in intestinal movement which persisted.

"hypertonic" Ringer's or Hartmann's solution and splanchnic block, are more efficacious.

SUMMARY

1. The causes of adynamic ileus are varied. They may be intra-abdominal or extra-abdominal. The most frequent cause of adynamic ileus is exposure to air and manipulation during laparotomy.

2. Adynamic ileus occurs earlier postoperatively than mechanical ileus. It is characterized by the absence of colicky, intermittent pain. Plain roentgenograms of the abdomen are of inestimable value in the diagnosis of all forms of ileus.

3. The treatment of adynamic ileus varies according to the type. The prophylactic treatment consists of abandonment of preoperative and postoperative catharsis and the avoidance of unnecessary trauma and peritoneal contamination during the performance of a laparotomy.

4. Physiologic ileus which occurs for varying periods of time following all laparotomies is treated by withholding the oral administration of all substances until nausea has ceased, by the application of heat to the abdomen, and by the administration of morphine. Water balance should be reestablished.

5. Severe adynamic ileus is treated by transduodenal decompression by means of indwelling nasal catheters and remineralization of the patient. Hypertonic salt solutions ("hypertonic" Ringer's and "hypertonic" Hartmann's solutions) injected intravenously stimulate the intestinal movement in adynamic ileus. In severe cases one or more enterostomies are frequently necessary in order to decompress the dilated intestine. A splanchnic block (splanchnic or spinal analgesia) is often efficacious. Drugs are of little or no value.

NOTE: We are indebted to Dr. F. C. Shute for permission to use the records of some of his hospital cases.

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DISCUSSION

Dr. G. A. Hendon, Louisville, Ky.: There are quite a number of valuable things we can do in the way of preventing ileus, or for the prophylactic phase of the treatment, if they are done at the right time. We know that enterostomies rarely do any good after the patient has relapsed, or if two or three days have elapsed before the enterostomy is attempted. I think we should formulate some standard whereby we would feel justified in doing an enterostomy at the time of the operation. I think the great prevailing influence that has acted against enterostomy has been the fear of fistula formation. I think we are almost past that and that we will in the future do enterostomies with a much freer hand. The great problem in adynamic ileus is drainage of the canal, and it is one which presents many obstacles, some of which are insuperable, but many things can be done that will be of value.

One form of enterostomy is that of placing a tube through the ileocecal valve. With the abdomen and the cecum opened and a Pezzer catheter threaded on a stylet it can be readily passed transcecal through the ileocecal

opening and will be retained by contraction of circular muscle fibers at the ileocecal junction. In that way we are able to direct our efforts nearer the seat of the trouble and give enemas from above downward instead of from below upward.

Another thing to consider is that local elevation of temperature is very discouraging to intestinal microorganisms and that the intestinal mucosa can readily bear a temperature of 120°F., which will inhibit bacterial growth.

Another point is in relation to calcium. I have found in all cases of peritonitis and ileus that the calcium content of the blood is reduced very low, sometimes as low as 4 mg. to 100 c.c. By the continuous intravenous administration of fluid containing gluconate of calcium we have been able to increase this calcium content; by using 40 to 60 or 100 grains a day, we have been able to increase the calcium in the blood up to normal, 10 or 12, and sometimes we have gone above it without deleterious effect. I think the foundation of treatment should be the support of the patient by supplying adequate fluid and nutrition without the use of the intestinal canal.

Dr. W. D. Gatch, Indianapolis, Ind.: It seems to me Dr. Ochsner's discovery that glucose inhibits the action of the intestines is very interesting, and I would like to ask to what he attributes this paralytic action of glucose on the bowel?

Dr. Alton Ochsner (*Closing*): In regard to Dr. Hendon's discussion concerning enterostomies, I think if one considers that enterostomy is largely a mechanical and decompressive procedure, it is obvious that an enterostomy should be done early. After changes occur in the bowel wall it is too late. It should be done before intramural strangulation occurs.

We do not know why glucose inhibits intestinal activity. We were given this lead largely by Carlson's work. Some years ago Carlson showed that glucose inhibited action of the stomach and we wondered whether this were true also of the intestine and found it was. Probably the effect is directly on the muscle.

This may be of extreme importance clinically. We have not been able to observe many of these cases clinically, and it takes thousands of cases to prove anything. We had noticed that patients with gallbladder disease had more postoperative distention than other cases, but thought it was probably due to handling of the viscera in the upper abdomen. In these cases we had been using large doses of dextrose, because of the liver damage. Recently we have fortified the dextrose with insulin and have not had this distention, so that we believe the former effect was due to the dextrose.

END RESULTS IN THE TREATMENT OF CANCER OF THE BREAST BY RADICAL SURGERY COMBINED WITH PREOPERATIVE AND POSTOPERATIVE IRRADIATION

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MUCH that is being written today concerning mammary cancer contains faulty philosophy upon the subject. When the radical amputation was devised in 1888 by Halsted and Willy Meyer independently, a new era began in the treatment of cancer of the breast. The radical operation had been carefully planned and it was proposed in the reasonable hope that in a certain percentage of cases, a complete eradication of the local disease could be assured, with a possible permanent cure. Today, this operation still remains the most effective weapon in the hands of the surgeon, and the advent of irradiation furnishes an additional useful therapeutic adjunct.

But the stage of the disease which was seen thirty-five years ago by the surgeons of that time was much more advanced than the earlier phases that are encountered in the surgical clinics of this country today. Moreover, as we are learning more about the disease, we are appreciating the futility of applying the radical surgical procedure in more advanced stages, with wide extension or metastasis far beyond the reach of surgery. We believe that these more advanced forms should be handled by palliative surgery, combined with irradiation. In this conviction, we are not in accord with Lewis and Rienhoff who feel that radical surgery should be done even in the advanced phases of mammary cancer. Radical amputation combined with the useful adjuncts of preoperative and postoperative irradiation, is the best method in hand

today for holding out the hope of a permanent cure of the ailment, but to have such a procedure successful, a proper selection should be made of cases which are really *operable.*

We cannot agree with these authors in the assertion that "The only point for which the surgeon must hold himself responsible, is that the condition may be cured locally." We disagree also with the viewpoint implying that no patient is ever cured of mammary cancer. We believe that this conclusion has been reached because the patients operated upon at the Johns Hopkins Hospital, and elsewhere, from 1889 for the ensuing quarter century, were most of them in more advanced stages of the disease, which today we appreciate are beyond hope of cure by surgery or any other means. In other words, much of the statistical material as to end results of the period up to and including 1915 had best be set aside as of little value in determining the present method of treatment. Unless the medical profession, the surgical group, and radiologists, as well, can reach a united conviction that early phases of mammary cancer are curable by radical surgery combined with irradiation, the whole effort in behalf of those suffering with cancer of the breast would seem absolutely futile.

This paper is a report of the end results in primary operable carcinoma of the breast at the Memorial Hospital, New York City, treated by radical amputation combined with preoperative and postoperative irradiation. The number of cases reported is 217. The earlier cases were operated upon late in 1916 and in 1917 and 1918. Since the Fall of 1919, when the Breast Clinic was established, the operations have been performed by the author and his colleagues. The general principles laid down by Halsted and Willy Meyer have been followed in the operative procedure. Five, seven and ten year results have been tabulated and no case is reported which was operated upon later than December, 1927.

DISTRIBUTION OF CASES IN FIVE YEAR PERIODS

The distribution of patients reported in this series by five-year periods is shown in Table 1 and Figure 1:

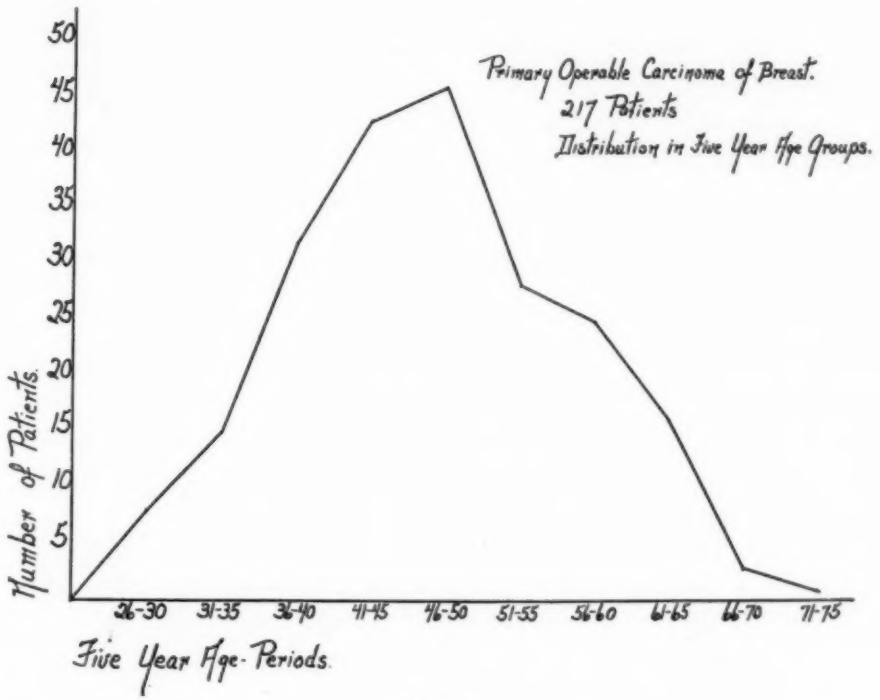

FIG. 1.

TABLE 1

DISTRIBUTION OF 217 CASES IN FIVE-YEAR PERIODS

Five-year Age Period	*Patients*
26–30	8
31–35	15
36–40	32
41–45	43
46–50	46
51–55	28
56–50	25
61–65	16
66–70	3
71–75	1

It will be seen that the highest incidence is in the five-year period between forty-six and fifty where we find 21 per cent

of the patients. The next five-year period is between forty-one and forty-five, where 20 per cent of the patients are found. In the decade between forty-one and fifty, 41 per cent of all the patients in this series are placed. Taylor has found the maximum incidence between forty-one and fifty, and this observation has been corroborated without exception by various authors.

CANCER OF THE BREAST IN THE YOUNG

The writer has called attention to the frequency with which cancer of the breast may be found in subjects forty years of age or less, and has pointed out the seriousness of the disease in these younger age groups. In the present series of 217 patients, 55 were forty years of age or under, constituting one-quarter of the entire number. The youngest patient under report was twenty-seven years of age. The following table illustrates the distribution of cases in five-year periods, in the younger women:

TABLE II

Age Period	*No.*
26–30	8
31–35	15
36–40	32

From inspection of Table 1, it will be seen that in the present series, there were more patients in the age period from thirty-six to forty, than in the age group from fifty-one to fifty-five. This fact should be clearly borne in mind by practitioners of medicine, surgeons and radiologists, for I have found a prevailing opinion that cancer of the breast seldom occurs under forty years of age. The doctor seems quite alert to the possibility of mammary cancer in the age group from fifty-one to fifty-five, but is apt to consider it a rare occurrence in the period of thirty-six to forty years of age. Out of 2663 cancers of the breast at Memorial Hospital, Pack found that 461 occurred in women under forty years of age, and a little more than half of the younger women were in the five-year period

from thirty-five to thirty-nine years of age. In our series, 58 per cent of the younger women were in the five-year period from thirty-six to forty. The results obtained in these younger

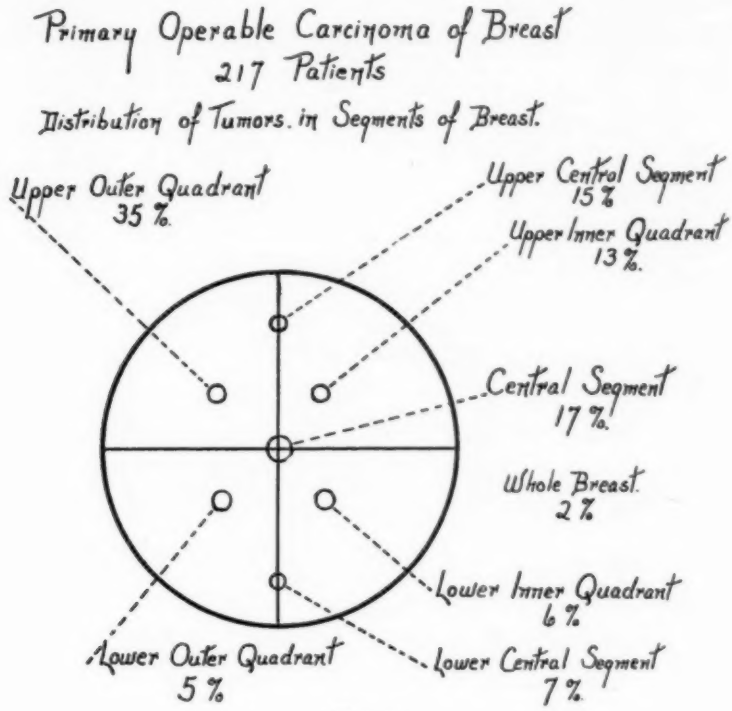

FIG. 2.

age groups will be discussed when the results for the entire series are considered.

DISTRIBUTION OF TUMORS IN SEGMENTS OF THE BREAST

Figure 2 shows the distribution of the tumors in the various breast segments.

One-third of all the tumors was located in the upper outer quadrant; half that number in the central segment; while the next two most frequent sites were in the upper central and upper inner segments. Practically two-thirds of all of the tumors were placed in the upper breast segments, while only one-seventh were found in the lower quadrants and segments of the breast.

THE FIRST SYMPTOM IN CANCER OF THE BREAST

From a practical standpoint it is important for surgeons, and more especially for physicians, to consider the first symptom noted by the patient indicative of beginning mammary cancer. Our concepts have been so settled concerning cancer of the breast that we are apt to lose sight of apparently insignificant signs which may point the way to a correct diagnosis. Moreover, it is important to consider what may be the first symptom of mammary cancer, noted by the patient, which may lead to an early diagnosis, at a time when treatment may be expected to give really satisfactory end results. Cancer campaigns lay emphasis upon the necessity for early diagnosis, but instructions are often lacking as to the method of procedure required to reach a correct diagnosis. It seemed to the author that it might be useful if a survey of a thousand cases were made with respect to the first symptom observed by the patient, furnishing a more significant percentage than

TABLE III

FIRST SYMPTOM IN CANCER OF THE BREAST

AN ANALYSIS OF 1000 CASES

Sign or Symptom	*No. of Cases*	*Percentage*
1. Lump in breast	740	74.0
2. Pain in breast	66	6.6
3. Enlargement of breast without a localized tumor	53	5.3
4. Retraction of nipple	26	2.6
5. Lump in axilla	18	1.8
6. Bleeding nipple	14	1.4
7. Pain in axilla, arm or shoulder	14	1.4
8. Backache	14	1.4
9. Erosion of nipple	13	1.3
10. Ulceration of breast	10	1.0
11. Inflammation of breast	10	1.0
12. Swelling of arm	6	0.6
13. Skin nodules	6	0.6
14. Pruritus of nipple	5	0.5
15. Supraclavicular lump	3	0.3
16. Dimpling of skin of breast	2	0.2
	1000	100 per cent

would have been possible with the limited group under report. Therefore, this number was chosen at random from the breast clinic with the results shown in Table III on page 410.

The patient noticed a lump in the breast as the first abnormal symptom in three-quarters of the cases of mammary cancer; this should lead every doctor to suspect any lump in any breast. We are taught that pain is never an early symptom of mammary carcinoma, but approximately one out of every 15 patients will tell you that a sticking, needle-like pain or a sense of vague discomfort was the first symptom she noted referable to the breast. It is, therefore, important for us to remember that if the patient complains of pain in the breast this in no wise excludes the presence of mammary cancer. A diffuse enlargement of the breast is the first subjective symptom noted in 5 per cent of the cases. This is a significant symptom and one should not be misled because a well-defined lump may not be palpated. Moreover, the type of disease characterized by diffuse enlargement of the mammary gland is usually an unfavorable case from the standpoint of ultimate prognosis. Retraction of the nipple comes next in frequency as an early symptom. This is of significance if the nipple had previously been normal on the affected side. Bear in mind, however, that a retracted nipple may have been present in a patient who had never noted the symptom. A lump in the axilla of the corresponding side is not an infrequent first symptom in mammary cancer. Any palpable mass in the axilla of a woman should suggest immediately to the doctor the necessity for careful examination of the mammary gland with the possibility of discovering a primary tumor in this location. We have frequently observed patients harboring a mass in the axilla, 4 or 5 cm. in diameter, with no visible or palpable evidence of cancer in the corresponding breast. Instead of observing such a case and waiting for developments, a biopsy by means of the aspiration method, or the use of a Hoffman punch, will frequently make an immediate diagnosis of metastasis from mammary cancer, so that proper treatment

may be carried out without delay. Our survey showed that a bleeding nipple was the first sign in one out of every 70 patients. A discharge of blood from the nipple of a woman past forty should immediately raise the possibility in the mind of the examiner that mammary cancer may be the underlying cause of the discharge. Lewis found that a bloody discharge from the nipple indicated cancer in 50 per cent of the patients, and Adair has fully corroborated this finding. In a similar proportion, the patient's first symptom may be a pain in the axilla, shoulder or arm. This symptom usually indicates a serious type from the standpoint of prognosis, for the symptom is probably produced by the pressure of neoplastic tissue in the axilla upon trunks of the brachial plexus. I have yet to see a patient, in which this was the first symptom, who has survived the five year period free of disease following radical amputation. Backache, produced by metastasis to bone from mammary cancer, is the first symptom in one out of every 70 patients. This is a distressing fact to contemplate, for it illustrates how an insignificant and unrecognized mammary tumor may spread to bones, producing a sufficiently active metastatic process to produce pressure and pain.

A young woman thirty years of age recently presented herself at the Admission Office of the Memorial Hospital, stating that she had suffered backache for several months. Her family physician referred her to a gynecologist who treated her over a period of two months with local applications to the vagina and cervix. No improvement followed this treatment, and of her own volition she came to the hospital seeking advice. A complete physical examination revealed a small mass in the left breast. This tumor was hard, showed some skin adherence and seemed to be a carcinoma. Pelvic examination was negative. Roentgen-ray plates made of the pelvis showed extensive metastatic areas in the pelvic bones and a crushed fourth lumbar vertebra, the site of another metastatic lesion.

An erosion of the nipple may be another significant symptom in about the same proportion of cases. Any chronic ulcerative lesion of the nipple should therefore be viewed with suspicion as a possible indication of an underlying mammary cancer.

Inflammatory cancer occurs in 1 per cent of the patients and is indicative of a highly cellular, rapidly growing malignant tumor. This form of the disease must be recognized and differentiated from abscess of the breast. Moreover, it is a type in which surgery should be withheld and external irradiation employed, for this latter method today is the only means at our command for producing growth restraint in such an active tumor process.

Swelling of the arm is the first symptom in 0.6 per cent of the patients and is produced by the pressure of neoplastic tissue in the axilla as well as in the infraclavicular and supraclavicular spaces. It always indicates a serious and usually inoperable type and the prognosis is always bad, whether surgical intervention is undertaken, or reliance placed upon irradiation.

A survey of Table III indicating the first symptom noted by the patient will reveal that about 10 per cent of all cases of mammary cancer, even though recognized early, are probably hopeless from the outset from the surgical standpoint. Table IV indicates how this figure of 10 per cent is obtained:

TABLE IV

UNFAVORABLE FIRST SYMPTOM; POOR PROGNOSIS

Symptom	*Percentage*
Diffuse enlargement of the breast without localized tumor	5.3
Pain in axilla, arm or shoulder	1.4
Backache	1.4
Inflammation of breast	1.0
Swelling of arm	0.6
Skin nodules	0.6
Supraclavicular lump	0.3
	10.6

But even though surgery holds out little or no hope for this 10 per cent, as far as the first symptom is concerned, many of these cases are of the radiosensitive type and irradiation affords a resource which should be made use of with greater promptness and greater frequency. The remaining 90 per cent of first symptom types present the hopeful and encouraging

group, where early and effective treatment will yield satisfying end results.

EARLY SIGNS OF MAMMARY CANCER

One is impressed more and more with the feeling that physicians, and surgeons too, are apt to suspect cancer only in the presence of some of its more advanced symptoms. It is highly important that we should bear in mind that the early signs of cancer, each by itself, may appear insignificant, but when several of these signs are grouped together, the diagnosis of cancer may be reached with reasonable certainty. It is only by careful consideration and grouping of insignificant signs that a correct diagnosis may be made. The author wishes to state at this point, that he finds it increasingly difficult to diagnose correctly the tumors of the mammary gland. Table v is a list of the early signs of cancer of the breast which should be kept in mind continually:

TABLE V

EARLY DIAGNOSTIC SIGNS OF CANCER OF THE BREAST

1. Nipple displaced upward and outward.
2. Beginning fixation of nipple.
3. Retraction of nipple.
4. Bloody discharge from nipple.
5. Deformity of breast contour.
6. Presence of lump in breast.
7. Lump is hard in consistency.
8. Lump is painless in three-quarters of all cases.
9. Skin dimpling or attachment.
10. Aspiration or punch biopsy may establish a diagnosis.
11. Carcinoma of breast is usually opaque on transillumination.

We have all been taught that skin adherence over a tumor of the mammary gland is almost diagnostic evidence of cancer. We see, day by day, more and more cases of this disease showing no skin adherence whatsoever. In fact, there seems to be an increasing number of patients, particularly young women with mammary tumors resembling fibroadenomata, which are in truth, infiltrating carcinomas. A recent experience may

serve to illustrate the difficulty of diagnosis in mammary lesions:

A woman forty-six years of age presented herself recently with the following history. In March of this year she first noted a small nodule in the upper middle portion of the right breast. She sought the advice of a prominent medical consultant in New York who assured her that the mass was of no moment and advised her to return several months hence when he would examine her again. He, however, suggested that she see a surgeon, which she did, and he corroborated the opinion of the former consultant. Being assured, she waited about two months and then consulted an old friend who is a prominent gynecologist in New York, and his findings were in agreement with the previous advice which she had received. I saw her about a month later. At that time, she had a tumor 3 × 2 cm. in diameter in the upper middle segment of the right breast, firm, but not hard in consistency. There was no skin adherence over it and it was not tender. There was no change in the position of the nipple or its appearance. Both breasts were of normal contour. There were no axillary nodes palpable. Because of the slight elongation of the mass, which would be somewhat unusual for a fibroadenoma, and because it did not have the ordinary feel of a cyst in the breast, and because of the woman's age, it seemed that the most probable diagnosis was mammary cancer. A wide local excision was done, gross examination revealed a typical carcinoma and radical amputation completed the operation.

Where men of such distinction fail to realize the early signs of mammary cancer, the educational effort in behalf of the medical profession does not seem without wisdom.

DIAGNOSIS

The clinical diagnosis of mammary cancer is becoming more and more difficult. The greater one's experience in this field, the more conscious he becomes of the many possible lesions in the breast. A decade ago, one felt quite secure in eliminating cancer of the breast as a possibility if the patient was below the age of forty. When one realizes that one out of every 6 patients suffering with mammary cancer is forty years of age or under (and in the present series one out of every 4), the question should always be raised in the mind of the surgeon whether or not he may be facing cancer, when the whole

clinical setting seems perfectly harmless. Moreover, the teaching of a decade ago concerned itself largely with a consideration of diagnostic signs which we now feel would clearly indicate advanced phases of mammary cancer. The author is convinced of the futility of attempting to cure the disease in these stages by any form of surgical procedure, however well planned and executed. It is apparent, then, that we have entered upon a new phase in our attack upon cancer of the breast. The practical problem facing us is twofold: (1) the education of the laity, teaching them to consult their physician at regular six month intervals when an adequate physical examination should be made and to seek without delay professional advice in the presence of any abnormal symptom or sign; (2) the education of the medical profession, that they may come to realize the futility of attempting to cure advanced stages of mammary cancer by any means, for palliation is all that may be accomplished under these circumstances. Moreover, doctors must come to appreciate the difficulties in diagnosis in this field with the necessity of having clearly before them the significant signs and symptoms of *early* mammary cancer.

OPERABILITY OF MAMMARY CANCER

Mathews in a recent article questions the wisdom of the restriction of surgery to what are called "operable cases." Lewis and Rienhoff likewise advise radical surgery "regardless of the extensiveness of the disease as long as it remains within possible operative limits." We are in accord with Gottesman who believes that when a radical operation is performed in the face of contraindications, the life of the patient is shortened. We also agree with him in the conviction that when the tumor is adherent to the chest wall, when the axillary nodes are fixed, or in the presence of a swollen or painful arm, surgery had best be withheld. We desire to state clearly our position on this subject.

A case is "operable," when the patient has a tumor of the breast that is not fixed to the chest wall, with or without

invasion of the axillary lymph nodes. This would appear a simple description of what constitutes an *operable* case. If there are wide multiple cutaneous nodules around the original tumor site, if there is a swollen or painful arm with extensive axillary metastasis, if the supraclavicular nodes are invaded, or if there is distant metastasis to the chest or bones, the case should be considered *inoperable* and radical amputation should be withheld. Radical surgical procedures upon cases of advanced mammary cancer shorten the life of the patient and are apt to bring discredit to surgery. Specialists in the field of tuberculosis might just as logically open their doors to all advanced forms of the disease, and then endeavor to show what a rational plan of treatment would produce in the matter of end results. Cases must be chosen which are really "operable" and this in no wise indicates an unwillingness to perform palliative operations where they are indicated. Those who object to the use of the word "operable" should see the large number of patients seeking admission at the Memorial Hospital, in advanced stages of the disease, exhibiting rapid recurrence and metastases following unwise radical procedures.

BIOPSY

The practice of obtaining a specimen for histological examination by incision into a tumor is undesirable and we believe, dangerous, because it may produce soiling of adjacent tissues by tumor cells. When a positive diagnosis of carcinoma cannot be made clinically, a small specimen may be safely obtained by using the aspiration method of Martin and Ellis, or the Hoffman punch technique. These procedures are in constant use at the Memorial Hospital, and we have found no practical reason why they should not be employed. One should bear in mind, however, that these methods require training in order to acquire a satisfactory technique, and we advise their employment only in the hands of specially trained men. In about 75 per cent of the patients, a positive diagnosis of cancer can be made by these methods, but where it cannot be

reached, or where the operator prefers not to employ them, wide local excision should be used to establish a diagnosis.

LOCAL EXCISION OF THE MAMMARY TUMOR PRECEDING RADICAL MASTECTOMY

Patients are certainly presenting themselves in earlier stages of the disease. This is probably due to the fact that the campaigns carried on throughout the country, by the American Society for the Control of Cancer and the American College of Surgeons, have caused patients to become more alert in the presence of symptoms referable to the breast. Wide local excision should be done with the full understanding on the part of the patient, that if cancer is revealed, a radical amputation will be performed immediately. The surgery should be done in a well-equipped operating room, with a pathologist available to pass immediately upon the tissue. In the vast majority of cases, if carcinoma is present, this fact can be recognized by gross examination, for the picture is usually unmistakable. If, however, a diagnosis cannot be made by gross examination, a frozen section should be done on the most suspicious tissue. The selection of tissue for diagnosis is usually made on the basis of its induration, as well as its gross appearance, so that the efficacy of frozen section depends, primarily, upon the gross choice of material.

In our series of 217 patients, local excision has been performed nineteen times prior to radical mastectomy. In 7 cases, the radical surgery immediately followed the local removal. In 12 cases, local excision was delayed for periods varying from a day to three weeks. A scrutiny of the charts reveals that the factor of delay does not seem to have influenced the prognosis. Peck and White reached a similar conclusion, many years ago, but felt that operation should not be delayed longer than one week. In the total number of 19 patients, the percentage of those alive and well at the end of five years was 53 per cent. We believe that this high percentage is due to the fact that 7 of the 9 patients free of disease at the end of

five years were in grade A by the Clinical Index of Malignancy, and the remaining B. In many of these patients, the preoperative diagnosis lay between fibroadenoma and carcinoma, and in a large proportion of the cases, the axillary lymph nodes were not involved. Upon theoretical grounds, it is the better course to do the radical mastectomy immediately following a local excision.

Some excellent surgeons make a practice of *incising* the tumor for diagnostic purposes, rather than doing a *wide local excision*. I believe with Eggers that there is less danger with the latter than by the former method. In addition to the possibility of the soiling of tissues by tumor cells, a further objection to the use of *incision* is that if the tumor proves to be benign, a further procedure of excision will be necessary to complete the operation. After the local excision has been performed, if carcinoma is revealed, the whole wound is carbolized and the carbolization followed by alcohol. The wound is then completely sutured and gauze saturated with iodine or picric acid is sutured over the line of incision and well beyond it. Later, in the radical dissection, an adequate protection is obtained by clipping a towel to the specimen side of the skin incision, completely covering the former operative field.

POSTOPERATIVE CARE

The patient having been transferred to bed, the arm is put in a position of abduction of 90 degrees from the trunk and a large pillow is placed against the trunk with the forearm resting upon it. This position is maintained for the first four or five days of convalescence. It is seldom necessary to give rectal instillations, hypodermoclyses or intravenous infusions, immediately following the operation, but these are administered whenever indicated. As soon as possible, the head of the bed is raised slightly, and the patient is encouraged to move from side to side. At the end of the first twenty-four hours, she is assisted, by the surgeon and the nurse, in her

attempts to move the arm and to raise it upward and outward. Later, she is encouraged to carry out this movement unassisted, and this program is repeated fifteen or twenty times a day, from this time on. The patient is allowed out of bed on the fourth or fifth day, and then is instructed to extend the arm up along the wall in her efforts to achieve better arm function. The drains are removed on the third postoperative day, and the running sutures on the sixth or seventh day, when adhesive tape support for the wound edges is occasionally applied. The tension sutures are removed on the tenth day.

PREOPERATIVE IRRADIATION

This useful adjunct to radical surgery has not received universal approval. We have been committed at the Memorial Hospital, during the past twelve or thirteen years, to the use of preoperative irradiation and we are still convinced that it is a useful adjunct to surgery. The objections usually raised to its use are:

1. Dangerous delay in undertaking surgery.
2. Delayed wound healing.
3. Ineffectiveness.

As to the first point, viz., the delay entailed before surgical intervention can be carried out, we have found no practical basis for this objection. Our former plan was to give four suberythema doses of high voltage *x*-rays (700 to 750 roentgen units) in four treatments, on alternate days, over the breast and drainage areas. Following this course of treatments, five to six weeks were allowed to elapse before radical amputation was undertaken. This plan is sound, but we have found it difficult to control the patient, during the period when she is awaiting surgical operation. Therefore, the plan has been modified, not because we feel that the delay is dangerous to the patient but because a shorter interval between irradiation and operation provides better control of the patient psychologically. Our present plan is to give 650 roentgen units,

using high voltage *x*-rays over the breast and drainage areas, giving two treatments on each of two successive days. Operation is carried out two to four days after the last treatment is given. The tumor, irradiated in this manner, will not show the histological changes which the delay of six weeks formerly gave us, but the dose has been delivered and the cells have been affected biologically, although histological changes may not be so evident.

Wound healing was satisfactory under the former plan of irradiation with delayed surgical intervention. Under the new method, using dosages of 650 roentgen units, primary healing of the wound occurs before the erythema appears and wound healing is not interfered with. If the operative procedure is delayed for a week to ten days following the first preoperative treatment, operation must be withheld for several weeks for wound healing will be interfered with as erythema appears. If the dosage of 800 roentgen units is employed the edges of the wound will be slightly inflamed and wound healing will be somewhat delayed.

This present plan of preoperative irradiation assures the surgeon that no undue delay will occur in proceeding with radical amputation, and permits satisfactory wound healing. Moreover, we are convinced that end results in the treatment of mammary cancer are better where preoperative irradiation is employed.

POSTOPERATIVE IRRADIATION

This therapeutic adjunct has been used as a routine procedure at the Memorial Hospital for more than a dozen years and we are convinced of its efficacy in preventing local recurrence. Increasing numbers of surgeons are agreed as to the efficiency of postoperative irradiation, joining in the opinion which has been held by many roentgenologists. Among those who believe that they have proven the efficacy of this form of irradiation are: Hoffman, Westermark, Portman, Trout, Pfahler, Hintze and Wintz. We give this irradiation four weeks

postoperatively when the wound is firmly healed and the patient is in good general condition. A high voltage cycle, each treatment consisting of 750 roentgen units, is given over the breast and drainage areas, on successive or alternate days.

If the operation showed the axillary nodes to be without metastasis, but one cycle is given, unless subsequent symptoms suggest the necessity for further irradiation. If, however, the axillary nodes are involved in the carcinomatous process, after the single cycle indicated, one or two cycles are subsequently given, preferably of one treatment each over the upper anterior, upper posterior, and lateral axillary regions, the radiation being directed toward the supraclavicular area where the first metastasis is likely to appear. A recent modification in the irradiation of the axillary space, devised by my colleague, Dr. Duffy, employs five portals of entry; one anterior, one posterior, one superior and two lateral, one with the arm in an abducted position and one through the outer aspect of the arm, in a position of adduction. This technique introduces approximately three erythema doses into the axilla and will, we believe, provide a more effective method of irradiation of this region. If considerable disease was disclosed in the axilla, treatment by the radium element pack may be substituted for the high voltage *x*-rays applied to the supraclavicular region.

The writer desires to caution surgeons and roentgenologists that the skin and subcutaneous tissues of the supraclavicular fossa, as well as the skin over the clavicle and immediately below it, will not stand frequently repeated irradiation beyond certain limits, without subsequent serious damage to the skin, the underlying cervical plexus and occasionally the clavicle itself. Experience has taught us that these regions will not stand more than three full erythema doses, whatever the interval between them, without permanent damage to underlying structures. We must appreciate that we are limited by the normal tissues present in our therapeutic possibilities by irradiation in this region. If this precaution is disregarded,

patients will ultimately find themselves with a distressing radiation necrosis of the skin or clavicle or an intractable neuritis of the cervical plexus. In the present series, this unfortunate complication occurred five times, in instances where a high involvement of the axillary nodes suggested the necessity of persistent efforts to prevent a metastasis in the supraclavicular fossa. All but one of these patients is alive without disease but the symptoms incident to over-irradiation are indeed disquieting.

END RESULTS

In calculating percentage figures, patients who were untraced are included; the two postoperative deaths are also included; but those dying of intercurrent disease without evidence of cancer are excluded from consideration.

End results in the series have been tabulated for five, seven and ten years, 217 patients being available for five-year figures, 130 patients for seven-year percentages, and 75 patients for ten-year calculations.

Table VI indicates the result of the calculations:

TABLE VI

END RESULTS; 217 PATIENTS

RADICAL MASTECTOMY PLUS PREOPERATIVE AND POSTOPERATIVE IRRADIATION

Five-year Results—217 Patients

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercurrent Dis. No Evidence of Cancer
88 41 per cent	13	109	5	2

Seven-year Results—130 Patients

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercurrent Dis. No Evidence of Cancer
45 35 per cent	5	73	5	2

TABLE VI—(*Continued*).
Ten-year Results—75 Patients

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercurrent Dis. No Evidence of Cancer
16 22 per cent	1	55	2	1

Figure 3 illustrates the survivals without disease at six month intervals in 217 patients followed for five years or more.

A comparison of five-year end results reported by different authors is shown in Table VII:

TABLE VII
FIVE-YEAR END RESULTS

	Cases	*Percentage Alive and Well Without Disease*
Trout (surgery only)	152	22
Buchholz (surgery only)	121	22.3
Klingstein (Mr. Sinai Hosp.)	57	23
Hintze (no postoperative irradiation)	....	30.1
Hoffman (postoperative irradiation)	82	30.5
Moschowitz (Mt. Sinai Hosp.)	89	34
White (Roosevelt Hosp.)	157	36
Lane-Claypon (British Cities)	2006	37.4
Mathews (surgery, some *x*-ray)	153	37.8
Westermark (preop. and postop. irrad.)	....	40
Mathews (incomplete oper., some *x*-ray inc.)	144	40.2
Lee (Mem. Hosp., surg., preop. and postop. irr.)	217	41
Portman (Cleveland Clinic, postop. irrad.)	103	42.7
McClure (Henry Ford Hosp., post. irr. for majority)	75	43
Hintze (postoperative irradiation)	183	53
Pfahler (postoperative irradiation)	240	55

The operators employing postoperative irradiation furnish, in general, the higher percentage figures of cures. Westermark and the writer, employing both preoperative and postoperative roentgen-ray therapy, have comparable percentages. It seems reasonable to assume that the added factor of irradiation has been responsible for the better end results.

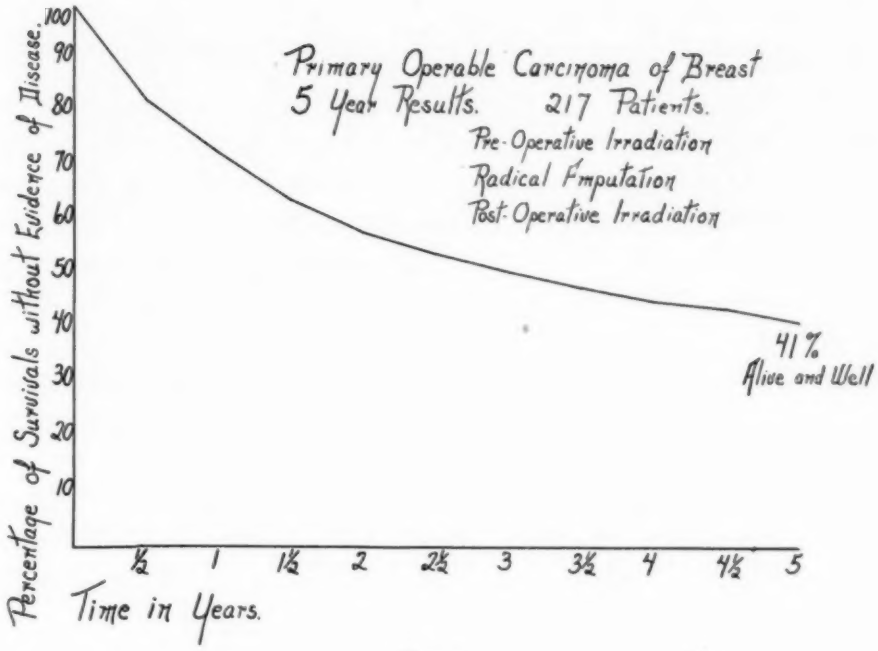
Primary Operable Carcinoma of Breast
5 Year Results. 217 Patients.
Pre-Operative Irradiation
Radical Amputation
Post-Operative Irradiation
41%
Alive and Well
Percentage of Survivals without Evidence of Disease.
100
90
80
70
60
50
40
30
20
10
½ 1 1½ 2 2½ 3 3½ 4 4½ 5
Time in Years.

FIG. 3.

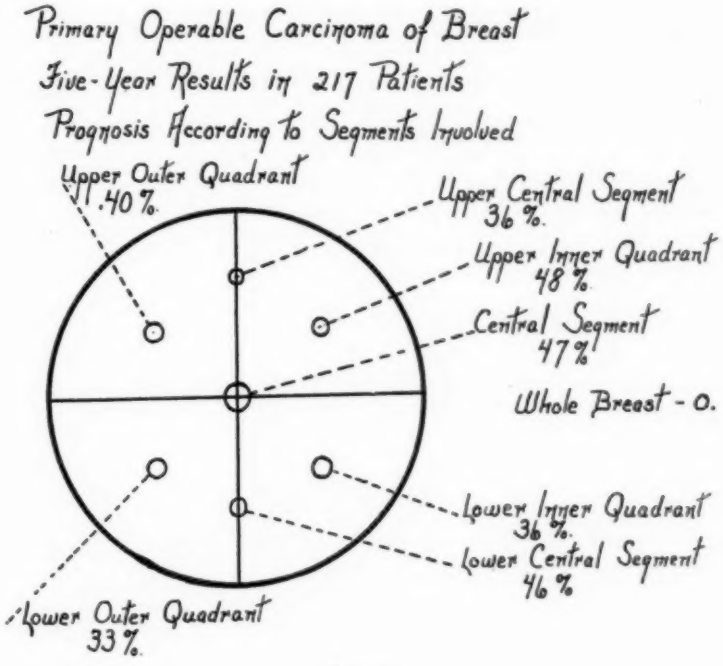
Primary Operable Carcinoma of Breast
Five-Year Results in 217 Patients
Prognosis According to Segments Involved
Upper Outer Quadrant
11.40%
Upper Central Segment
36%
Upper Inner Quadrant
48%
Central Segment
47%
Whole Breast - 0.
Lower Inner Quadrant
36%
Lower Central Segment
46%
Lower Outer Quadrant
33%

FIG. 4.

PROGNOSIS ACCORDING TO SEGMENTS INVOLVED

Figure 4 shows the prognosis according to segments involved in our five-year results in 217 patients.

Contrary to our previous impressions, the best prognosis was furnished in the cases having *upper inner* segment tumors, for we had believed that in this group early pulmonary metastasis would cause poorer end results. The prognosis is almost equally good where the tumor occupies the central breast segment or the lower central segment. The poorest percentage figures were obtained when the tumors were placed in the upper central segment or in the lower inner and lower outer quadrant.

An interesting comparison of five-year end results is obtained when the younger women and those above forty are separated, in calculating end results. Table VIII illustrates this contrast:

TABLE VIII
FIVE-YEAR END RESULTS

55 Patients—Forty Years of Age or Under

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercur. Dis. No Evid. Cancer
15 27 per cent	6	31	3	0

162 Patients over Forty Years of Age

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercur. Dis. No Evid. Cancer
73 45 per cent	7	77	3	2

A comparison of the percentage figures for these two groups demonstrates the serious character of the disease in the younger women. We are not familiar with any report of a group of cases of mammary cancer in which such a high incidence of younger women occurs. The conclusion seems justified that our figure of 41 per cent for five years, for the entire 217

patients, has been lowered because of the unusual proportion of those in the younger age group.

The declining ratio of those alive and well in the five, seven and ten year periods illustrates the necessity of a prolonged follow-up of the cases, which has been well shown by the study of Lewis and Rienhoff.

INVOLVEMENT OF AXILLARY NODES

Data are available in 179 of our patients as to the histological proof of cancer, or its absence, in the axillary nodes removed at operation. Metastasis to the axillary nodes was proved in 103 patients, while non-invasion of these nodes was demonstrated in 76 patients. Table IX shows the five-year end results in these two groups:

FIVE-YEAR END RESULTS

Nodes Not Involved (Proved Histologically)—76 Patients

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercurrent Dis. No Evidence of Cancer
55 72 per cent	1	18	2	0

Nodes Involved (Proved Histologically)—103 Patients

Alive and Well	Alive and Rec.	Dead	Untraced	Died—Intercurrent Dis. No Evidence of Cancer
24 23 per cent	7	69	1	2

Table X gives the percentage figures of various authors for five-year end results, considering the factor of node involvement.

A survival without evidence of disease at the end of the five year period of between two-thirds and three-quarters of the patients is to be expected, when the axilla is free of involvement, whereas one-quarter of the patients survive, free of disease, when the axillary nodes are invaded at the time of operation. This is a considerable salvage in the latter

TABLE X
FIVE-YEAR END RESULTS

Author	*Nodes Not Involved (Proved Histologically)*		*Nodes Involved (Proved Histologically)*	
	Patients	Percentage Alive and Well	Patients	Percentage Alive and Well
Greenough and Simmons	16	56	46	24
Sistrunk and MacCarty	86	65	132	22
Mathews	45	64	99	29
Harrington	332	67	1092	26
Smith and Bartlett	21	67	27	26
Peck and White	26	65	43	23
Lee	55	72	103	23

group, and would appear to justify the attempt at radical removal in the presence of axillary metastasis. An error of 16 per cent occurs in the preoperative estimation of the presence or absence of metastatic carcinoma in the axillary nodes. This figure is approximately the same, whether the surgeon believes that metastasis has not occurred or his physical examination convinces him that nodes are already invaded. This uncertainty in the diagnosis of axillary invasion should lead the surgeon to proceed with radical amputation, not placing too much dependence upon his physical findings in the axilla.

PREVIOUS LACTATION

Many writers describe the proportion of single and married women in reports of mammary carcinoma, but a much more significant differentiation concerns itself with the history of prior lactation. We have been taught that cancer of the breast occurs more frequently in women who have had previous lactation. This appears to the writer to be an incorrect assumption in any report on mammary cancer, for although a larger number of patients will be found who have previously lactated, the percentage of this group in the total population of women over twenty-five years of age is probably much

higher than of women who have never lactated. The writer has sought in vain for trustworthy statistics which would give the accurate proportion of women who have lactated, as compared to those who have not. No absolute proof of a higher incidence of mammary cancer in the latter group can be proven, although I believe it occurs.

In our series data are obtainable as to the factor of prior lactation in 156 patients, 107 (69 per cent) of whom had had prior lactation, and 49 (31 per cent) whose breasts had never lactated. The calculated results in the two groups are shown in Table XI:

TABLE XI
FIVE-YEAR END RESULTS

100 *Patients—Previous Lactation*				48 *Patients—No Previous Lactation*			
Alive and Well	Alive and Rec.	Dead	Untraced	Alive and Well	Alive and Rec.	Dead	Untraced
43 43 per cent	5	50	2	23 48 per cent	2	22	1

Eight cases of mammary cancer with co-existent pregnancy or lactation have been excluded from this table. The difference in percentage figures may indicate that the disease is somewhat more menacing in the patients who have previously had lactating breasts.

CO-EXISTENT PREGNANCY AND CO-EXISTENT LACTATION IN THE PRESENCE OF MAMMARY CARCINOMA

Authors are in general agreement concerning the menace to the patient furnished by co-existent pregnancy in the presence of mammary cancer. Sistrunk and MacCarty have never seen a survival for five years after operation where mammary cancer developed during pregnancy or in the period of lactation. Harrington feels that operation is unjustifiable in the presence of pregnancy, regarding the prognosis as hopeless. In this report, 7 patients were pregnant at the time

that carcinoma of the breast was discovered. In 3 instances a therapeutic abortion was performed, in one case two weeks prior to radical mastectomy, in a second at the time the radical surgical operation was carried out, and in the third, two weeks following radical surgical intervention. None of these 7 patients survived the five-year period free of disease, and all but one died before the three-year period had been reached. The one instance of survival beyond three years was a woman who had a therapeutic abortion performed at the time radical amputation was done. She was alive with recurrence at the end of five years but was dead six years after surgical intervention.

The prognosis in the presence of lactation is probably better than with pregnancy. We have one patient in this series with co-existent lactation. She lived three years and six months from the date of radical amputation.

TABLE XII

PREGNANCY OR LACTATION COMPLICATING CANCER OF THE BREAST: DURATION OF LIFE AFTER RADICAL AMPUTATION

Case No.	*Years*	*Months*
1	0	11
2	1	4
3	1	7
4	1	11
5	2	9
6	2	10
7	3	6
8	6 (Rec. 5 yrs.)	0

The prospect of a permanent cure of the disease in the presence of pregnancy or lactation appears very remote. We feel, however, that radical surgery and therapeutic abortion, combined with preoperative and postoperative irradiation, are probably the best method of attack in a certain proportion of these cases. Where the breast is diffusely enlarged or the disease is of the inflammatory type with early wide extension to the axilla, the best plan of pro-

cedure would appear to be an immediate therapeutic abortion, relying upon irradiation to handle the mammary disease and its extensions.

CANCER OF THE BREAST IN THE MALE

Pack showed that 1.24 per cent of mammary cancer occurred in the male. McClure, in his series of 150 patients, reported but one male suffering from mammary cancer. In the present series, 9 patients in the operable stage of the disease presented themselves at Memorial Hospital, representing 4 per cent of the 217 patients under report. The youngest patient in the male group was thirty-one years of age, and the oldest, sixty-five. The ages of the nine patients were, thirty-one, forty-two, forty-nine, fifty, fifty-two, fifty-seven, sixty-four and sixty-five. McClure states that two-thirds of the male patients suffering from mammary cancer are over sixty years of age. In our group of 9, but 2 (or 22 per cent), were over sixty. Although the disease is not encountered often in the male below forty, it does occur rarely.

Wainwright found in his study of 111 male patients that but 19 per cent survived the five-year period free of disease. Two of our 9 patients survived for five years without evidence of recurrence (22 per cent). The number of patients is too small to make the figure of any significance. The two who survived were grade A cases, graded by the Clinical Index of Malignancy. Of those succumbing to the disease, two died in less than one year, three in less than two years, one in less than three years and the remaining patient was alive with disease at the end of five years. He succumbed to cancer at the end of seven years and one month. We are impressed with the seriousness of the prognosis in cancer of the male breast, and Wainwright's figures further substantiate this impression. The disease metastasizes earlier, even in the presence of an apparently insignificant mammary lesion. The diagnosis of cancer in the male breast is difficult, for the case may present the physical signs of a placque of mastitis

beneath the nipple, without the characteristic hardness so frequently encountered in the female. A diagnosis of mastitis in a male, in or past mid-life, should be made only after careful scrutiny, and the diagnosis proved after wide local excision.

POSTOPERATIVE MORTALITY

In the entire series of 217 patients there have been 2 postoperative deaths, both from a complicating pneumonia. The first occurred in a woman sixty-two years of age who was admitted to the clinic in April 1920. She seemed a poor operative risk. The patient herself was opposed to surgical intervention but I finally persuaded her to undergo operation, a preoperative *x*-ray cycle having previously been given. She developed pneumonia on the first and died on the seventh postoperative day. The second patient, thirty-eight years of age, succumbed to lobar pneumonia on the sixth postoperative day. This gives a mortality of 0.9 per cent. Table XIII is a compilation of a few published mortality figures.

TABLE XIII
POSTOPERATIVE MORTALITY

Surgeon or Hospital	*No. of Cases*	*Percentage*
Lee (Memorial Hosp.)	217	0.9
Mathews (St. Luke's)	218	1.3
Taylor	5208	1.3
St. Luke's Hosp	....	1.6
White (Roosevelt Hosp.)	157	2.9
Lane-Clayton	2006	Just below 3
McClure (Henry Ford Hosp.)	150	4
Lewis and Reinhoff (Johns Hopkins Hosp.)	950	6.4

The last percentage figures given concern operative material for the past forty-two years, in the earlier decades of which many of the safeguards in preoperative preparation had not been fully developed. The operator must assure himself that the patient is in good physical condition before

surgery is undertaken. Radical amputation should not be done if the patient exhibits the slightest vestige of a coryza or a pharyngitis, even when no rise in temperature exists.

Radical amputation would not appear to be a very dangerous major surgical procedure, if a mortality rate approximating 1 per cent is achievable.

SKIN GRAFTING AND LOCAL RECURRENCE

The study of Lewis and Rienhoff demonstrates that one should always be on the lookout for late recurrence following radical mastectomy, for they have shown how frequently local recurrence may appear many years after the surgery was done. The longest period between operation and local wound recurrence which the writer has seen was thirty-eight years, when a small nodule appeared close to the old scar. As our own series under report is followed for a longer period of years, it is not unlikely that additional local recurrences will appear.

The authors just quoted feel that if a wide area of skin is excised at operation, necessitating skin grafting, local recurrence is less likely in the operative field, and the vast majority of the operations which they reported included a skin-grafting technique. McClure in a recent article states that 45 per cent of his patients were submitted to skin grafting, and he apparently has the same conviction that wide removal of skin with subsequent skin grafting diminishes the percentage of local recurrences.

McClure reports 38 per cent of skin recurrences, but 45 per cent of his cases were skin grafted. Lewis and Rienhoff report 97 local recurrences out of 324 patients operated upon by wide excision followed by grafting, a percentage of 30. In a closed plastic procedure which was performed in 117 patients, there were 46 recurrences, a percentage of 38. The figure here would seem to be in favor of the skin-grafting operation, but this is not in accord with our experience in

the present series. In a study as extensive as theirs with a follow-up over a long period of years, there is no doubt that late local recurrences will be found in and about the wound area and it would therefore be impossible to compare their percentage of local recurrences with ours.

A completely sutured wound was obtained in 95 per cent of our patients, by the extension of the incision downward, to or beyond the costal margin, providing sufficiently mobile flaps to allow a complete closure. It is surprising to see how large an area of skin may be removed, and still permit a complete suture of the wound.

Of the 217 cases in this report, local recurrence appeared 28 times, or in 13 per cent of the patients. Skin grafting was employed in 13 cases and in all, save two, the operation was delayed for a number of days to a week. There were 5 local recurrences in the 13 cases, or a percentage of 38. In 4 instances, recurrent skin nodules appeared along the wound. In the fifth patient, a small recurrence appeared in the area from which the skin graft was removed, although there was no recurrence in the skin grafted area itself. In contrast, skin recurrences were found locally in 23 instances, in the 204 patients in which a closed wound was obtained, an equivalent of 11 per cent.

The larger percentage of recurrences in the skin grafted patients may have been influenced by the more extensive types of the disease which were being handled, requiring in the mind of the operator, a wider sacrifice of skin, which would make the disparity in percentage figures less significant. Moreover, a skin grafted area may limit the efficacy of post-operative irradiation, for it must be postponed for a longer period, and a less effective dose may have to be employed, that in the presence of a well-healed linear scar. The author favors a completely closed wound, if this can be secured without wound tension, because in our hands local recurrences have been less frequent and postoperative irradiation can be given more effectively.

CLINICAL INDEX OF MALIGNANCY

The author proposed, in 1923, a method for the grading of cases of mammary cancer from purely clinical data, believing that this method of estimating the grade of malignancy was effective and dependable. The four major factors, which were used in the calculations, were: (1) age, (2) the presence of lactation (including pregnancy), (3) the rate of growth and (4) the extent of the disease. A weight, or value, was assigned to each of these four clinical factors, arbitrarily, only after a survey of a large number of patients to determine what would appear to be a reasonable value for these factors. The index was so built up that no case with involved nodes could ever fall in the lowest grade of malignancy; that every case with co-existent lactation or pregnancy would have to fall in the moderately or highly malignant groups; and in a similar manner other important clinical considerations were carefully studied to make the index really workable. Any patient presenting herself before a surgeon may be graded by this method within thirty seconds by the simplest mental calculation. Although in the index, as first published, no mention was made of pregnancy, the author chose the word lactation

TABLE XIV

	Weighting Factor	*Gradation Factors*
Age	A = 2	A_g { Over 55 = 1; 41 – 55 = 2; 40 or under = 5
Lactation (including preg.)	L = 3	L_g { Absent = 0; Present = 3
Rate of growth	R = 4	R_g { Slow = 1; Moderate = 2; Rapid = 4
Extent of disease	E = 5	E_g { Small 3 cm. or less = 1; Large = 2; Nodes present = 4

to include the pregnant and lactating women and has always included the pregnant women within the lactating factor. After the Clinical Index was constructed, an earnest effort was made to build up a workable clinico-histological index, but it was found impossible to join these two types of estimation in grading, in any serviceable formula. The weighting and gradation factors concerned in the construction of the index are indicated in Table XIV.

The clinical index of malignancy for any individual patient is calculated by multiplying the value of each weighting factor by its gradation factor and adding the results, as:

$$\text{C.I.M.} = 2A_g + 3L_g + 4R_g + 5E_g$$

An inspection of Table XIV reveals that the smallest possible clinical index is 11:

$$\text{C.I.M.} = (2 \times 1) + (3 \times 0) + (4 \times 1) + (5 \times 1) = 11$$

The highest possible figure is 55:

$$\text{C.I.M.} = (2 \times 4) + (3 \times 3) + (4 \times 4) + (5 \times 4) = 55$$

Based upon such a calculation, patients may be placed in one of three grades:

Grade A = 11–25 = relatively benign
Grade B = 26–39 = moderately malignant
Grade C = 40–55 = highly malignant.

The advantages of grading of patients by means of the Clinical Index of Malignancy over the grading obtained by the Steinthal method are as follows:

1. The Clinical Index of Malignancy takes cognizance of the age of the patient and this has a very important bearing upon prognosis. In the present series, 55 patients forty years of age and under gave a percentage alive and well for five years of but 27 per cent. One hundred sixty-two patients over forty years of age gave a percentage alive and well for the five-year period of 45 per cent. The Steinthal method of grading does not recognize the age factor.

2. When pregnancy or a lactating breast is found in the presence of mammary cancer, the outlook for the patient is exceedingly grave. A survey of the present series showed that none of the 8 patients (seven that were pregnant and one that was lactating) survived the five-year period free of disease. The Steinthal method of grading does not recognize the importance of co-existent pregnancy or lactation in attempting to estimate clinical grading.

3. The clinical index of malignancy lays due emphasis upon the rapidity of growth of the tumor in evaluating the clinical setting, whereas the Steinthal method disregards this important factor.

The Steinthal classification is based entirely upon the extent of the disease but the clinical index considers this but one of four important factors determining the seriousness of the clinical setting.

In the present series, 166 patients were classified according to the author's clinical index of malignancy and Table XV indicates the end results at the termination of the five-year period. The table is drawn dividing the patients into four groups, "A" the relatively benign group; "B−" the lower grades in the moderately malignant group; "B+" the higher grades in the moderately malignant group; and "C" the highly malignant cases:

TABLE XV

FIVE-YEAR END RESULTS

166 Patients Graded by the Clinical Index of Malignancy

	Alive and Well	Alive and Recur.	Dead	Untraced
Grade A	34	0	6	1
41 patients	(83%)			
Grade B−	26	2	28	2
58 patients	(45%)			
Grade B+	11	5	21	0
37 patients	(30%)			
Grade C	5	2	23	0
30 patients	(17%)			

This table demonstrates the excellent result which may be expected in the grade A patients, the relatively poorer results in the grade B− and grade B+ cases, and the low percentage figure obtained in the grade C cases. If the grade B− and B+ are combined the figures for the three grades are:

TABLE XVI

	Per Cent
Grade A	83
Grade B	39
Grade C	17

The method of grading is effective and we urge its use in future by the members of this Association, who are attempting to obtain dependable data upon the end results of the treatment of mammary cancer.

HISTOLOGICAL GRADING

All the tumors under report have been proved cancerous by histological examination. Dr. Ewing has said that he felt that a histological grading afforded a better estimate of the malignancy of the tumor than the ordinary description of the pathological types. During the past five years, histological grading of tumors (following the plan of Broders) has been carried out in the pathological laboratory by Dr. Ewing and later also by Dr. Stewart. Prior to this time, pathological reports did not include a histological grading, so that the number of patients who were graded is but 85.

Table XVII gives the end results for five years of the 85 cases that were graded histologically.

TABLE XVII

FIVE-YEAR END RESULTS

85 Patients Graded Histologically

	Alive and Well	*Dead or Rec.*
Grade I	5 (100%)	0
Grade II	21 (44%)	27
Grade III	7 (22%)	25

Although the groups of cases are small, the total shows the significance and importance of histological grading in estimating the prognosis. We feel that all mammary carcinomas should be graded histologically and reports given for the end results in each of the grades. If this could be done, as well as the grading of cases by the clinical index, some basis of comparison would be furnished, as groups of cases are reported, from which dependable conclusions may be drawn.

ARM FUNCTION

The factors which have to do in obtaining a satisfactory function of the arm are as follows:

1. An incision placed, wherever possible, to the inner side of the axilla, and not crossing the base of the axilla.

2. The preservation of a part of the clavicular portion of the pectoralis major.

3. The application of a dressing which exerts firm pressure upon the base of the axilla, obliterating as far as possible the axillary space, and never confining the arm by bandage in a position of adduction close to the trunk.

4. The maintenance of the arm after operation, in bed, in a position of adduction to 90 degrees from the trunk.

5. Active mobilization of the arm, to start at the end of the first twenty-four hours, and a persistent continuance of this mobilization by the patient, with the guidance of the surgeon and nurse. This active mobilization should be practiced fifteen or twenty times every day, beginning at first with gentleness and encouragement.

6. A tractable, coöperative patient. If the patient will not coöperate and will not persist in active mobilization, scar tissue will surely form in the axilla and adequate abduction and satisfactory arm function will never be obtained. In certain racial groups, with neurotic tendencies, it has been difficult to obtain coöperation.

In the vast majority of our patients, the arm function is satisfactory.

LYMPHEDEMA OF THE ARM

Lymphedema is one of the distressing sequelae following radical amputation for cancer of the breast. Many years ago Halsted pointed out that it was often due to the presence of a low-grade infection in or about the wound, and this is, I believe, a more frequent factor in its production than the severance of small lymphatic channels coming up the arm. In the present series we have encountered lymphedema twenty-five times or in 12½ per cent of the total number of patients operated upon. The five most serious examples that we encountered in the series have already been referred to as largely accounted for by an extensive fibrosis from over-irradiation of the supraclavicular region. The one additional instance of a marked and seriously disabling lymphedema is described in the following brief case history:

S. W., a colored woman, developed a tremendously swollen arm following postoperative irradiation fibrosis. The disability and weight of the arm finally convinced us that a removal of this extremity was necessary, and an amputation at the shoulder joint was done. Except for some slight nerve irritation in the shoulder stump, the patient is comfortable and able to carry on her ordinary household activities. There is no evidence of any active disease six and one-half years after radical amputation was done.

Lymphedema may begin shortly after the operation, or may appear several months or a year postoperative. If it develops after this period, one should suspect a beginning recurrence high in the axilla or in the supraclavicular fossa.

The relief of lymphedema is a discouraging problem. We have had no satisfactory results from the use of Handley's lymphnagioplasty, and discontinued its employment several years ago. The Kondoleon operation has never yielded, in our hands, a complete restoration of the extremity to its normal size. The incisions are usually made along the inner side of the arm from the axilla to the wrist, sparing the elbow region, and along the outer aspect of the extremity, from the scapular region to the wrist. A strip of fascia is excised, the length of

the incision and a width of about ½ inch or a separation of its two cut edges for a similar distance (without excision), is accomplished. An instrument is then introduced at right angles to the incision, at various levels into the muscle planes, in the hope of establishing new communications between the deep and superficial lymphatics. The wound is closed with interrupted sutures. In a small number of patients, the arm has been reduced perhaps a quarter in size, but this is not a very satisfactory result from the patient's viewpoint.

Two patients in the clinic, having marked lymphedema, developed an abscess at the inner aspect of the elbow. When the abscess was incised and thoroughly drained, in one patient the arm was quickly and completely restored to normal size, and in the other, a marked diminution in size followed. We have sought without success an explanation of these remarkable results.

Patients should be cautioned without alarming them, that some slight swelling of the arm may occur following operation, and that if lymphedema does appear, no criticism may be raised of the operative procedure employed, for lymphedema will develop in a certain percentage of cases in spite of meticulous surgical technique.

FOLLOW-UP

The weekly follow-up clinics carried on by each clinical department of the Memorial Hospital offer an effective means of keeping in touch with our patients. Five patients left the clinic before the expiration of the five-year period and it has been impossible to trace them. This gives a follow-up figure of 98 per cent upon 217 patients for a period of five years. A follow-up figure of 96 per cent was obtained in 130 patients followed for seven years, five of the cases being untraced. Two patients were lost track of in the ten-year follow-up upon 75 patients, giving a follow-up figure of 97 per cent. This excellent follow-up record has been achieved through the enthusiastic support of my colleagues on the Breast

Service and the loyal coöperation of the Social Service Department of the Hospital.

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[For Discussion see Article of Dr. Nicolson*]

* This will appear in the June issue of The Journal.

CANCER IS CURABLE

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CHICAGO, ILLINOIS

IN 1912, the Clinical Congress of Surgeons of North America was asked by Dr. Thomas S. Cullen, of Baltimore, a member of this association, to arrange a series of talks on cancer for a meeting to which the public could be invited. The Academy of Music of Brooklyn was filled to capacity by the intelligent group of three thousand laymen and women who were induced by the Clinical Congress to attend. The audience was thrilled to be taken into the confidence of the half dozen eminent surgeons who related, in simple language, facts about cancer that should be within the knowledge of every layman.

Encouraged by the success of this meeting, Dr. Cullen wrote an editorial[1] which read in part as follows:

> One evening of the Clinical Congress of Surgeons of North America was given over to the consideration of cancer of the uterus. It has long been realized that most of these cases reach the surgeon too late for operation, and it was apparent to all that the medical profession must wage a campaign of publicity if the women of the country were to be made aware of the fact that in the early stages of the disease a large number of the cases could be cured by operation.
>
> Former educational campaigns, aiming to enlighten the general practitioners as to the necessity of referring all cases of cancer to the surgeon early, have proved of little value, simply because the physician as a rule sees the patient but a few days before he or she is referred to the surgeon. It was therefore clear that it was the people, and not the physician, that should be educated. . . .
>
> The Clinical Congress appointed a Committee of five consisting of Dr. H. C. Taylor, New York; Dr. E. C. Dudley, Chicago; Dr. C. Jeff Miller, New Orleans; Dr. F. F. Simpson, Pittsburgh, and Dr. Thomas S. Cullen, Baltimore, as Chairman, to wage this campaign. . . .

[1] The cancer campaign. *Surg., Gynec. Obst.*, 16: 102, 1913.

THE AMERICAN SOCIETY FOR THE CONTROL OF CANCER

Through the influence of this Committee, during the meeting of the Congress of Physicians and Surgeons of North America held in Washington later in the year, the American Society for the Control of Cancer was organized (May 22, 1913), with headquarters in New York City. The first Executive Committee included the members of the Clinical Congress Committee; and the first Board of Directors, of which I was a member, was an amplification of the Executive Committee.

In 1922, the American College of Surgeons appointed a Committee on the Treatment of Malignant Diseases, with Dr. Robert B. Greenough, of Boston, as Chairman. In coöperation with several large clinics, particularly in the East, this committee began its survey of cases of carcinoma of the cervix. Subsequently the survey was extended to include cancer of the breast and of the tongue, and later of all regions of the body. Cases were recorded in which the diagnosis was proved and in which careful follow-up had been conducted. The first report of five-year cures was presented by the Committee in 1929.

In 1926, Dr. Bowman C. Crowell, an Associate Director of the College, became secretary of this Committee; and the detail of correspondence was later taken over by the College under the guidance of Dr. Greenough. Dr. Crowell was elected a Director of the American Society for the Control of Cancer in 1929, and Dr. Greenough is also a Director and a member of its Executive Committee. Between these two organizations, the Cancer Society and the College of Surgeons, there has been the closest coöperation.

CANCER CLINICS

Through its Committee on the Treatment of Malignant Diseases, the College in 1930 undertook to develop throughout the United States and Canada a series of cancer clinics in connection with approved general hospitals and other approved

institutional clinics where cancer is specially treated. By this means we can extend to all interested groups the privilege that was enjoyed by the limited number of clinics with which the Committee of the College has coöperated; and also we will be enabled to compile more comprehensive records of cancer and cancer cures.

The difficulties, ethics, finances, and plans of this stupendous undertaking have been carefully considered. It is our desire to have the voluntary coöperation of participants, and to safeguard the proposed cancer clinics by establishing standards under which they can be approved after personal surveys. It is along these lines that the standardization of hospitals has been conducted by the College.

COÖPERATION WITH THE AMERICAN SOCIETY FOR THE CONTROL OF CANCER

The Board of Directors of the American Society for the Control of Cancer met with the Board of Regents of the College in New York, in October, 1931. The undivided activities of both organizations were discussed, the College's cancer clinic program was announced, and a mutual and friendly understanding of individual activities established.

As a preliminary, we sent an outline of our plan to each approved hospital in the United States and Canada, and to existing clinics. These organizations were asked to study our proposal, and to respond as to their attitude. Our hospital surveyors are instructed to present the plan to the staffs and officials of each hospital they visit. From the former source we have received 888 replies, and from our hospital visitors, 467. From these, we selected the best prospects in the larger centers, and they are now being visited by representatives of the College, two physicians who have a comprehensive understanding of our cancer clinic program. Detailed results of 467 personal visits are recorded, and about one-half of the country has been covered. Excluding duplicates, 1009 actual contacts have been made. Our representatives report a

sympathetic response in almost every instance. Not one serious opposition has been registered.

To summarize our results: There are 158 definitely organized cancer clinics, at least 100 of which merit full approval; 155 others have discussed the plan with our trained visitors, and either have started organization or shown an inclination to do so immediately.

THE PLAN

Upon what basis is this ambitious plan predicated?

1. Cancer is curable.

2. Cases of incipient cancer, properly treated, show by far the greater number of cures.

3. Incurable cancers are almost invariably the result of failure of early recognition of the disease.

4. Late discovery of cancer is due to ignorance of the patient of the early signs of the disease, and frequently to the neglect of practitioners who fail to advise their patients to have periodic health examinations.

5. Wise propaganda will supplant the ignorance of the patient with knowledge, and induce the practitioner to popularize the periodic health inventory among his clients.

6. Thousands of laymen and women have been educated through the far-reaching sectional meetings that have been conducted by the College during the past twelve years. These meetings, which are ethically advertised in the lay press and through other means, are addressed by six to ten specialists who tell the public what they should know of preventive medicine and of personal health problems. There is always a frank discussion of the early signs of cancer.

7. A wholesome by-product of these meetings is the demand by many of those who attend for a periodic health examination by the family doctor. These individuals have demonstrated to the reluctant or indifferent practitioner that preventive medicine is most interesting and profitable, both to the patient and to the doctor.

8. This propaganda was successfully inaugurated by the National Tuberculosis Association, and is advocated by the literature of philanthropic organizations: the Gorgas Memorial, the American Heart Association, the American Social Hygiene Association, and others, the recent teaching in our medical schools, newspaper health columns, and magazine articles. As a result, many people now recognize personal health facts as they have long recognized public health facts.

9. All of this wholesome dissemination of information is impelling the educated layman to demand facilities not only for early diagnosis in cancer, but for early diagnosis of every disease. Hence the doctors are beginning to realize that they must possess in their own communities laboratory and scientific apparatus that will insure the highest efficiency in the diagnosis and treatment of disease.

PRACTICAL FACTS WHICH ENCOURAGE ESTABLISHMENT OF COMMUNITY CANCER CLINICS

The American College of Surgeons, through the activities of its cancer boards, including the Registry of Bone Sarcoma which has been active during the last decade, has collected data from existing clinics and individual practitioners that are most significant and demand consideration.

At the yearly meetings of the College these facts are correlated and presented to physicians and surgeons, to hospital administrators and hospital staffs, and in ethical form to the lay press. The facts include:

1. Report of five-year cures of cancer.

2. Articles contributed by eminent clinicians which outline forms of treatment of cancer of particular organs with a record of five-year cures.

3. Conclusions which prove that the 150,000 deaths from cancer that occur each year would be reduced by at least 33 per cent if every clinician possessed enterprise, adequate facilities for obtaining early diagnosis of cancer, and proper equipment for treatment.

TYPE OF CLINICS CONSIDERED FOR APPROVAL

1. Cancer institutes and cancer hospitals.
2. General hospitals (part pay or pay) and dispensaries.
3. Public hospitals (non-pay) and dispensaries. (Examples: Municipal, County, and State.)
4. Organized group clinics. (Examples: Well-known established clinics now functioning.)

GENERAL PRINCIPLES

The American College of Surgeons is dedicated to surgeons and their problems. It is not organized for profit. Disinterestedly it is supporting scientific organized medicine and surgery, especially in reference to preventive and curative principles as applied by clinical practitioners; it is supporting an ethical propaganda of education of the public in relation to organized medicine and personal health; on thrift principles it is financing its own budget; it is endeavoring to maintain the independence of the practitioner of medicine by furnishing him, without prohibitive expense and in his own community, facilities for the scientific diagnosis and treatment of his patients.

The College is aware, from its experience in surveying and bettering the hospitals of the continent, that a big job is a complicated one, and that this bigger job, which was begun ten years ago and touches the foundations of the present trend of the scientific profession of medicine and its relation to personal health, in contradistinction to public health, is one that will require the earnest coöperation of the individual members of the profession if the independent practice of preventive and curative medicine is to be safeguarded. The College is endeavoring to insure the independence of the family doctor through the establishment of community clinics, Health Inventoriums, for general diagnosis and treatment, where scientific doctors of medicine and the public may coöperate.

Our clinics have their problems:

1. Through what means will the public learn of diagnostic and cancer clinics? If a clinic is organized to warrant approval of the College, this fact will be made known to the medical profession; the College, after a representative number of clinics have qualified, will release the information to the lay press, as is the custom with accepted hospitals, but the name of the clinic will be eliminated; the public will be directed, through the same publicity, to obtain facts about approved clinics from the family doctor, approved hospitals, or from the officials of their respective county medical societies.

2. The American College of Surgeons in its sectional and clinical meetings will continue to inform the audiences that in their midst they possess diagnostic cancer clinics. The question "Where are these clinics"? will be answered by: "Ask your family doctor."

EXTREME CARDIAC DECOMPENSATION FOLLOWING TRAUMATIC ARTERIOVENOUS FISTULA OF THE LEFT SUBCLAVIAN VESSELS

J. M. MASON, M.D.

BIRMINGHAM, ALA.

IT has been definitely established that, in addition to the local and peripheral symptoms produced by arteriovenous aneurysms of the larger blood vessels, pronounced cardiovascular changes often taken place.

These changes may include dilatation and hypertrophy of the heart; acceleration of the pulse; low diastolic pressure with high pulse pressure; fall in pulse rate and rise in blood pressure following temporary occlusion of the fistula; cardiac murmurs, dilatation of the artery proximal to the fistula, and the development of a condition simulating aortic insufficiency.

The extent and gravity of systemic effects will depend upon the degree of cardiac decompensation which may develop in a given case.

Two outstanding papers dealing with these phases of arteriovenous fistula have been presented before this Association, one by Rudolph Matas[1] in 1923 and one by Mont Reid[2] in 1932.

Matas lays down the following general principles concerning conditions in the fistula that determine or influence cardiovascular effects: (a) the size of the fistula; (b) the volume and force of the arterial stream that is short circuited into the communicating vein; (c) the caliber of the vessels involved; (d) the proximity of these to the heart; (e) the duration of the fistula; (f) the age of the patient; (g) the coexistence of antecedent cardiovascular disease.[1]

In discussing arteriovenous fistula of the subclavian vessels, I shall present the case of a woman previously healthy, who, as the result of a stab wound in the left chest, developed an

arteriovenous fistula between the left subclavian artery and vein.

The extreme degree of cardiac decompensation which rapidly followed the formation of the fistula was arrested by ligation and excision of the vessels entering into the formation of the fistula, and the patient has been enabled to resume her household duties.

The case gives dramatic confirmation to the observations of Matas and Reid in the papers referred to, both in the rapidity of development of cardiovascular changes and in the relief which followed operation. So far as I can ascertain, this is the only case of arteriovenous aneurysm of the subclavian vessels in which operation was undertaken for relief of cardiac symptoms.

TREATMENT

WITH SPECIAL REFERENCE TO ARTERIOVENOUS ANEURYSMS OF THE SUBCLAVIAN VESSELS

The "noli me tangere" attitude formerly held in regard to arteriovenous aneurysms in general has been changed to one of active surgical intervention.

The results which have been obtained in the surgical treatment of arteriovenous aneurysms of the subclavian vessels justify, I believe, a less pessimistic attitude than has been held by many and which has been forcibly expressed by Sir George Makins when he says: "My own experience leads me to regard operation for arteriovenous aneurysms in this region as the most difficult and dangerous of any that can be undertaken,"[4] and by Sir Wm. I. de C. Wheeler, who says: "Results of operations upon arteriovenous aneurysms of subclavian vessels are very discouraging and operations are attended with great difficulty."[5]

This belief is based on the results obtained in 27 operations in the series of 59 collected cases. Cures are reported in 20 instances; definite improvement in 2; no improvement in 2; and death in 3.

Of the unimproved cases, Veiel[6] operated on the ninth day for secondary hemorrhage. Trophic and vascular disturbance followed, with marked disability of hand and arm.

In Tichy's case (Abstract 3), the patient was refused operation in another clinic ten months after receipt of his injury, on the ground that symptoms were not proportionate to danger of operation. When seen by Tichy five years later, the condition of the arm was such that shoulder joint amputation was the only procedure possible, and the fistula could not be attacked.

The first case of Matas is classed as improved, since operation was followed by some degree of gangrene and by ischemic paralysis. It must be noted that there was extensive injury to the brachial plexus in addition to the arteriovenous damage. Matas attributes some of these after effects to too early operation (ninth day), while Halsted attributes the gangrene to the preservation of the lumen of the vein by careful suturing.[3] My own case is classed as improved for the reason that, while cardiac decompensation was promptly arrested, there remain cardiac changes which may be permanent.

One of the deaths was reported by Wattman in 1843 in the preantiseptic period[6]; another by Vallos in 1900, where a gelatin injection resulted in infection. Fatal hemorrhage followed the operation which was undertaken for relief of suppuration.[6]

Another death was reported by Makins in 1919, and resulted from the entrance of air into the subclavian vein.[4]

This fatality is the only one chargeable to direct attack upon a subclavian arteriovenous aneurysm under modern operating conditions, and was purely accidental.

TECHNIQUE

Local anesthesia will prove of great advantage and should be employed whenever possible.

I believe, also, that the manubrium as well as the clavicle should be resected at the beginning of any operation where it is likely that the left subclavian artery may have to be exposed in its first portion, or where the innominate is likely to be exposed.

Reid[7] lays down the following indications for operation, and I believe that they are generally accepted:

> In some cases, hemorrhage, increasing hematoma, infection, and very rarely, acute cardiac symptoms make it necessary to operate soon after the injury. When none of the foregoing complications make operation imperative, delay presents the following advantages:
>
> 1. A good collateral circulation develops, which permits excision of the fistula without fear of gangrene.
> 2. The injured vessels become thoroughly healed, making their dissection easier and safer.
> 3. Infection is less likely to occur.
> 4. Spontaneous healing may take place.

He says that "It is generally true that abnormal arteriovenous lesions of the arms, neck, and head are better tolerated than those of the lower extremity."[7]

I take it that this is the reason that so few instances of serious cardiovascular disease were encountered in the series of arteriovenous aneurysms of the subclavian vessels which I have investigated.

LIGATION OF ARTERY AND VEIN

It has been definitely established by the clinical and experimental work of Makins,[4] Holman,[13] Barney Brooks,[10] La Roque and others,[11] that when the main artery to a given part is ligated, the accompanying vein should also be ligated. Gangrene is less likely to follow.

Exceptions to this are the subject of some discussion. An interesting contribution by Pemberton and McCaughan was reported recently.[12]

CASE REPORT

Frances G., colored female, aged thirty, the mother of three children, was admitted to the Hillman Hospital at 12 M. on January 17, 1932, one half hour after having been stabbed below the left clavicle near the border of the sternum.

1. She was in considerable shock, with rapid respiration, a temperature of 97.4°F., pulse 100, B.P. 80/40. The admitting officer noted on the chart

that "The heart is negative." She was put to bed after receiving proper treatment for shock and hemorrhage.

2. On the following morning, January 18, she was seen by Dr. W. H.

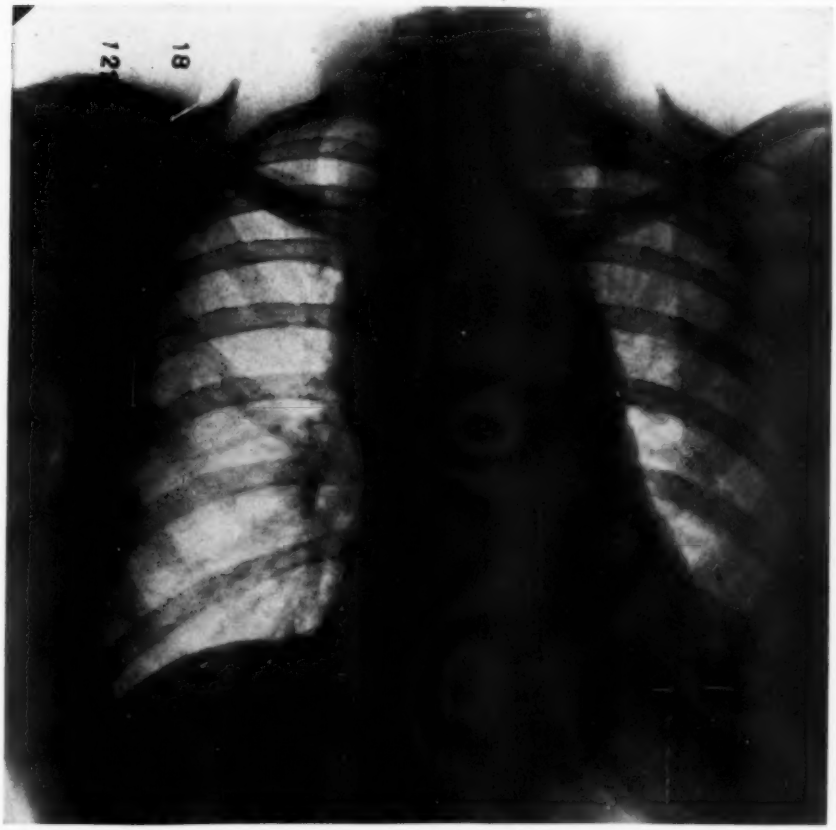

FIG. 1. January 18, twenty-four hours after injury. No hemothorax. Heart base rather broad and margins not clear cut.

Beddow of the visiting surgical staff, who made an examination of the chest and did not discover any thrill or bruit. Blood examination at this time showed Hb. 50 per cent, and R.B.C. 3,070,000.

3. On the following morning, January 19, I saw her and noted a thrill in the region of the wound and in the supraclavicular space, also a churning bruit over this area and extending over the base of the heart and into the neck.

4. After two restless nights, disturbed by cough and elevation of temperature to 101°F., the churning bruit had extended widely over the chest, with a corresponding increase in the intensity of the thrill.

5. By January 24, cough, fever and restlessness had subsided to the extent that no further opiates were needed, and during the subsequent week the bruit and thrill were somewhat quieter.

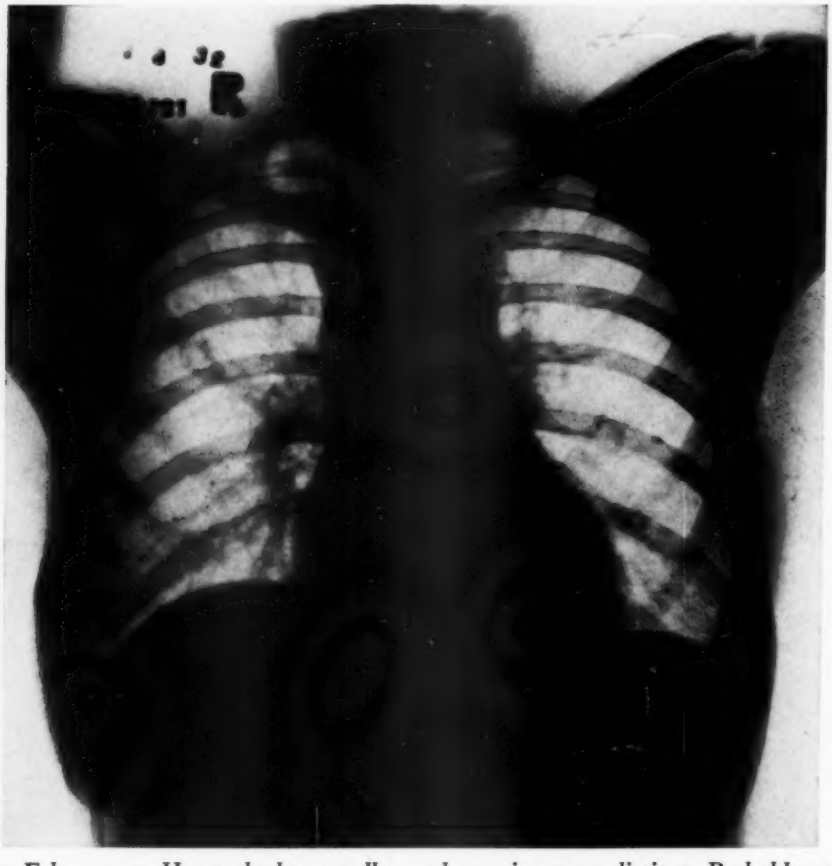

FIG. 2. February 3. Heart shadow smaller and margins more distinct. Probably some mediastinal hemorrhage has been absorbed.

6. By February 2, the patient was able to be out of bed, and while the thrill and bruit were present and widely disseminated, she showed no signs of broken compensation.

7. It was our intention to defer operation until sufficient time had elapsed for the establishment of a collateral circulation; hence on February 9, the patient was allowed to go home, with instructions to return for observation at the end of ten days.

8. She returned on February 19, as instructed, when her condition was found to be about the same as when she was discharged. She was told to return on February 29 for further observation. She failed to return on this date, as she had become too ill to leave her bed.

9. Some days later when seen at home she was confined to bed with marked circulatory embarrassment, and was advised to return to the hospital.

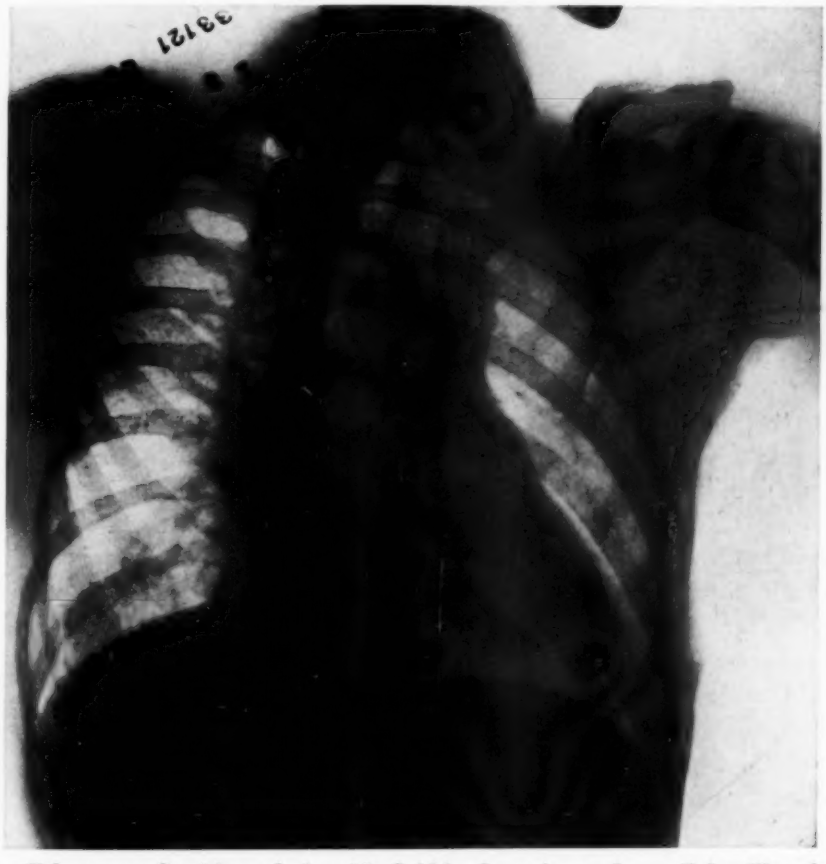

FIG. 3. February 3. Semi-lateral view. No fluid in chest. Aorta shows slight dilatation in both views.

10. She was readmitted on March 24, at which time I made the following notes:

"Since discharge from the hospital the condition has rapidly changed for the worse. The heart is enormously dilated; thrill and bruit are widespread; there is a left pleural effusion; the feet and legs are swollen; the liver extends 6 inches below the rib margin and is very tender; the abdomen is distended and the peritoneal cavity contains fluid; dyspnea and cough are present and are much aggravated by exertion; the urine is normal."

"Peripheral symptoms are not marked, the force of this injury expending itself largely on the heart. There is no tumor; there are no varicosities

in the arm and no edema is noted. The pulse is definitely weaker than on the right side, and the systolic blood pressure is lower." Readings on three different days showed:

Right	Left
126/74	105/80
125/80	110/80
128/78	110/70

The rapid progress of the cardiac decompensation made it imperative to operate without further delay. On March 28 the left pleura was aspirated, withdrawing 1200 c.c. of serosanguinolent fluid after which she was prepared for operation.

First Operation: March 31. Exploration of the neck under 1 per cent novocaine infiltration anesthesia, preceded by sodium amytal-morphine-atropine.

Every surgeon who contemplates an operation which may involve exposure of the first portion of the left subclavian artery should read Halsted's classical essay on "Ligations of the left subclavian artery in its first portion."[3] The difficulties of the operation have not been exaggerated. The plan of my first operation was not sufficiently broad. Instead of following the advice of Halsted and resecting in the beginning the manubrium sterni as well as the clavicle, only the clavicle was resected. This was a mistake.

With the clavicle resected, the common carotid artery, the internal jugular, the subclavian, and the left innominate veins were exposed and isolated.

The third portion of the subclavian artery was also accessible, but it was found impossible to expose the first portion of this vessel at a point low enough in its course to get below the fistula without resecting the outer half of the sternum and perhaps the first rib.

When this conclusion was reached, the operation had consumed more than three hours and I did not think it wise to put any further burden upon the patient at this time, so the wound was closed.

Very little reaction followed and the wound healed without infection.

On rest in bed, digitalis, purgation and sedatives, the patient was somewhat more comfortable. The pleural effusion recurred, and it became necessary to aspirate the chest three times between the first and subsequent operation; 750 c.c. of fluid being removed on April 8 and 21 and 550 c.c. on May 2.

During this period there was noted a steady fall in blood pressure with a decided weakening of the pulse. The bruit and thrill persisted without abatement, and no real improvement could be noted.

On May 3 the blood pressure on right side registered 100/60, and the reading on the left arm could not be accurately ascertained.

Second Operation: Seventy-seventh day after receipt of the injury.

FIG. 4. March 26. Two days after readmission. Enormously dilated heart with left pleural effusion.

On May 3, again under local infiltration anesthesia with 1 per cent novocaine preceded by sodium amytal-morphine-atropine, the second operation was undertaken, and lasted from 1.35 to 6.05 P.M.

After resection of the left half of the manubrium and the anterior half of the first rib, the dissection was continued along the lines of the former operation. We succeeded in ligating the subclavian artery in its first and third portions, the left subclavian, left innominate, and left internal jugular veins, and in excising the entire vascular mass included between the ligatures, together with the fistula.

The communication was in that area where the subclavian and internal jugular veins unite to form the left innominate vein, and in a correspondingly low site on the subclavian artery.

The subclavian artery was ligated with heavy braided silk at a point approximately ¾ inch from the aorta. The other ligatures were of No. 2 chromic catgut.

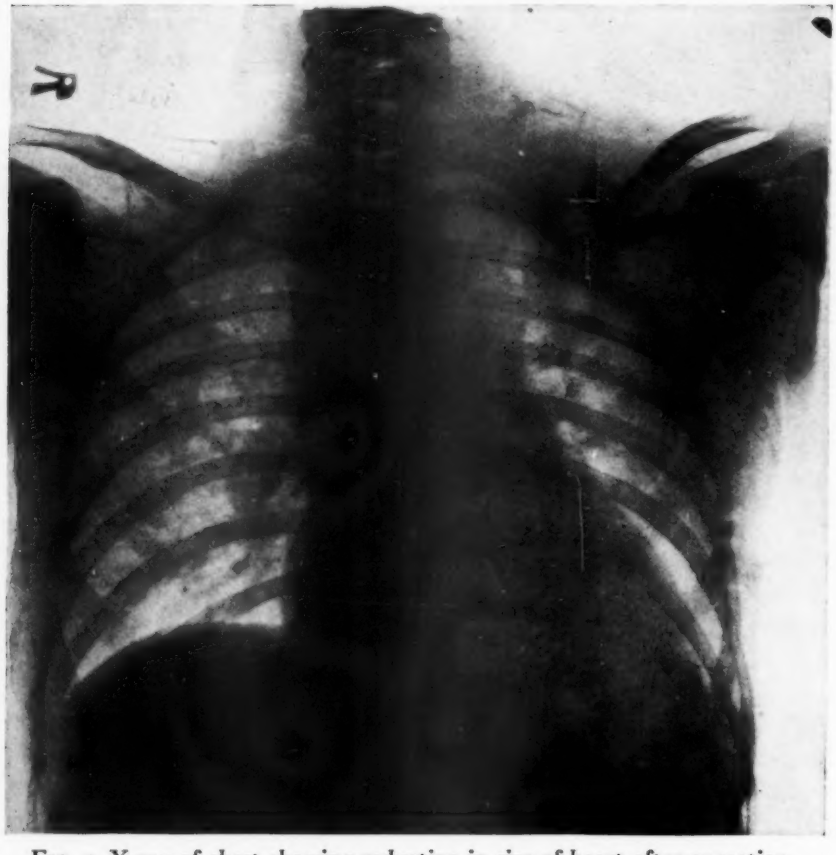

FIG. 5. X-ray of chest showing reduction in size of heart after operation.

Owing to the dense scar tissue of the knife wound and of the former operative wound it has been difficult to prepare the excised specimen in a manner satisfactory for demonstration, but Figure 9 gives some idea of the fistula.

A particularly interesting feature of the operation was the demonstration of Branham's bradicardiac phenomenon at the time that the ligature on the subclavian artery was tightened.

The pulse, which had been carefully noted at fifteen minute intervals during the entire operation, registered 124 when we prepared to tighten the ligature. Immediately upon the closure of the fistula it dropped to 104, where it remained throughout the operation.

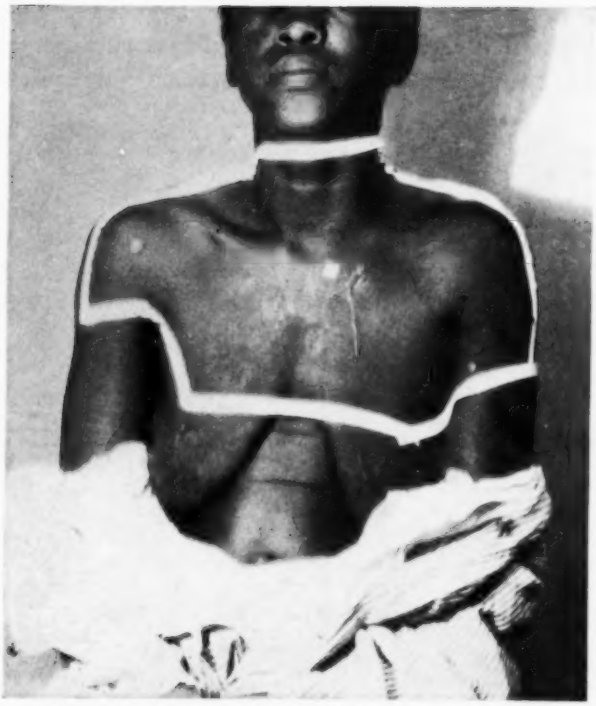

FIG. 6. February 9. Photograph of patient showing scar of stab wound. Inside white line is area of bruit at its height.

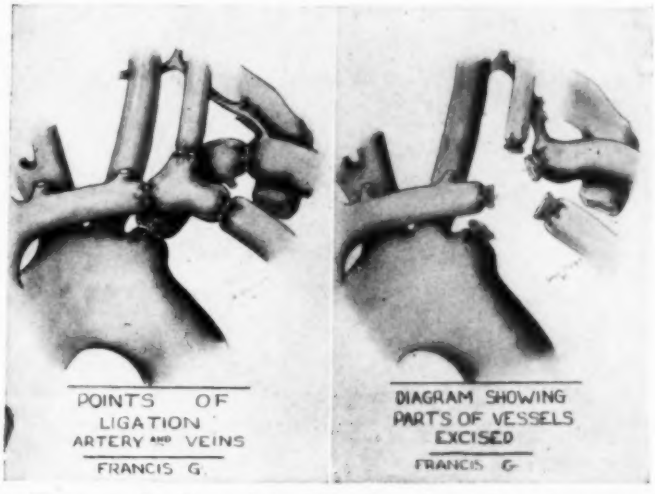

FIG. 7. Diagram showing points of ligation of vessels and parts excised.

The operation was well borne and there was no attending shock.

This is attributed to the use of local anesthesia throughout, and to the further fortunate circumstance that the operation was completed without

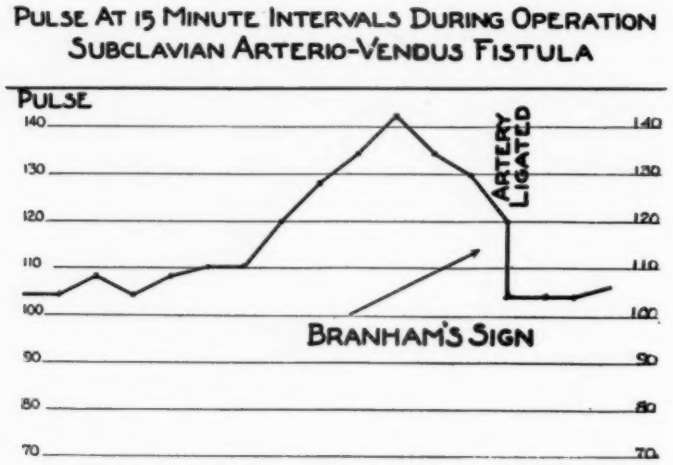

FIG. 8. Chart of pulse during operation.

FIG. 9. Specimen showing material excised and site of fistula.

material loss of blood, and that there was no damage to important nerves, or to the pleura, lung, or pericardium.

The patient remained in the hospital until September 15, during which time cardiac compensation was gradually restored. Since her discharge

she has shown steady improvement and has resumed her active household duties. There has been no recurrence of the pleural effusion, the quality of the pulse has improved and the blood pressure has risen to a more

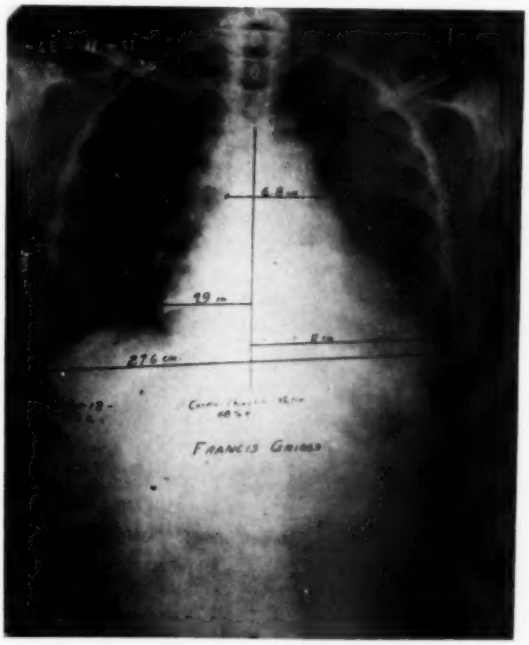

FIG. 10. Teleoroentgenogram. November 12, 1932. Heart still enlarged.

normal level.

The heart, though well compensating, still shows an aortic thrill and bruit as well as a soft double blow at the mitral valve. I attribute these to the extensive damage which the heart sustained before the fistula was closed.

In substantiation of the statement made at the beginning of this report that "the patient was previously healthy," the following data are submitted:

She states that she had never, until after the receipt of the injury, had any symptoms referable to her heart or lungs. In March, 1931 she was admitted to the Hillman Hospital for confinement, at which time the chart records the statement that her heart was normal. Wassermann and Kahn reactions were negative. In July, 1931 she was in the hospital for a few days suffering from a minor injury. No special mention was made of the heart at this time, but the nurse's chart shows a pulse of 80–80–90, on three successive days, with no record of weakness or irregularity. On admission, January 17, 1932, the admitting officer states "the heart is negative," and on the following day, Dr. W. H. Beddow, attending surgeon, after a careful examination of the chest, found no thrill or bruit. These were not discovered until the following day. Wassermann and Kahn reactions on this

admission, and also when she was readmitted in March, were negative. These three negative reactions give evidence that no syphilitic heart or arterial disease was present.

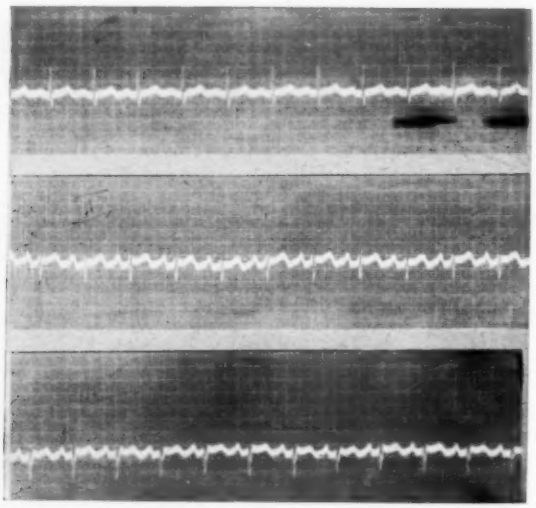

FIG. 11. Electrocardiogram, November 12, 1932.

REPORTS OF ARTERIOVENOUS ANEURYSMS

1902	Matas' collected series[6]	18	
1919	Makins' series[4]	11	
1920	Callender's collected series not previously tabulated[8]	8	
1925	Reid's series[9]	4	
See abstracts.	Other cases reported since 1920, including the one of the author	14	
See abstracts.	Additional cases reported by Dr. Matas in personal communication Dec. 7, 1932	4	
Total cases		59	
	Deaths	5	
	Mortality		8.4
Operative cases		27	
	Cured	20	
	Improved	2	
	Unimproved	2	
	Deaths	3	
	Mortality		11.1
		27	
Non-operative cases		32	
	Spontaneous cure	2	
	Deaths	2	
	Mortality		6.25
	Improved, Unimproved } Unascertainable		

Fifty-nine reports of arteriovenous aneurysms of the subclavian vessels have been collected (see table of sources on p. 464).

ANALYSIS OF RESULTS IN 27 OPERATIVE CASES

	Cured	*Imp.*	*Unimp.*	*Died*
From Matas' series 1902[6]				
Wattman	..	..	..	1
Von Rotter	1			
Veiel	..	..	1	
Vallos	..	..	..	1
Erdman	1			
Matas	..	1		
From Callender's series 1920[8]				
Siago	1			
Berkley & Bonney	1			
Makins' cases[4]	1	..	..	1
Reid's cases[9]	3			
Reports since 1920 including the case reported in this paper				
Noon Abstract no. 1	1			
Tichy Abstract no. 3	..	..	1	
Laspiur Abstract no. 4	1			
Constant Abstract no. 6	1			
Holman Abstract no. 8	1			
Gilcreest Abstract no. 10	1			
Benedetti Abstract no. 11	1			
Harberer Abstract no. 7	1			
Pemberton Abstract no. 9	1			
Mason	..	1		
Personal communication Dec. 7, '32, Dr. Matas, reports 4 additional traumatic cases. All operative recoveries and complete cures. Abstract. no. 14	4			
Total cured	20			
Improved	..	2		
Unimproved	..	..	2	
Died	..	..	..	3

SUMMARY

1. In a previously healthy woman, an arteriovenous fistula in the first portion of the left subclavian vessels was diagnosed forty-eight hours after the infliction of a stab wound beneath the left clavicle.

2. Locally, during the healing of the wound a thrill and bruit became marked and widespread. There was no complaint of severe pain, but the patient was much disturbed by the noise of the bruit and by a sensation of oppression in the chest. There was no tumor.

3. Peripherally there were no varicosities, neither was there any edema of the extremity. The pulse in the involved side was weaker and the blood pressure was lower than on the sound side.

4. Centrally and systemically she developed, within six weeks of the receipt of the injury, every discomfort which could well take place from a decompensated heart: pleural and peritoneal effusions, enlargement of the liver, edema of the lower extremities, cough, dyspnea, dilated heart, low blood pressure and weakened pulse.

5. Following ligation of the subclavian artery in its first and third portions; and the subclavian, internal jugular, and left innominate veins, and excision of the included sections of these vessels together with the fistula, the signs of broken compensation have disappeared, the quality of the pulse has improved, and the blood pressure has risen to a more normal level. The patient has been able to resume her household duties and is steadily improving. The heart, though well compensating, has sustained damage which will probably be permanent.

ABSTRACT OF CASES REPORTED SINCE JANUARY 1, 1920

Abstract No. 1. Noon's Case.[14] Arteriovenous aneurysm left subclavian vessels in second portion, caused by shell wound May 17, 1912. Discharged from Army November 17, 1917 on account of pain and weakness of arm. Admitted to hospital June 1, 1921 with pulsating swelling above and below clavicle; dilated and tortuous veins over upper extremity and into axilla; arm swollen and livid; varicose ulcer forearm; bruit over left half of chest, left radial pulse weaker; heart and lungs normal.

Operation: September 25, 1921 Chloroform and ether. Inner half of clavicle and left half of manubruim removed. Left innominate vein exposed and retracted. Subclavian artery ligated with No. 3 silk in its first portion. This caused complete cessation of pulsation and no further ligations were done. Rubber tube drained for twenty-four hours.

Course: Eight weeks after operation: No pulsation, but slight bruit could be heard.

Result: Swelling and ulceration relieved; excellent power in hand and arm.

Abstract No. 2. Wheeler's case.[15] Reports briefly before the Surgical Section of the Royal Academy of Medicine of Ireland, 2 cases of arteriovenous aneurysm of subclavian vessels of four years' standing in soldiers. Thrill and bruit widely distributed over chest.

Proposed not to operate unless special indications arose, as he says "Results of operations on arteriovenous aneurysm of subclavian vessels are very discouraging and operations are attended with great difficulty."

Abstract No. 3. Tichy's case.[16] Soldier suffered gunshot wound of left shoulder September 20, 1915. On July 9, 1916, was admitted to surgical clinic of the University of Breslau, with aneurysmal tumor, swelling of arm, varicose veins of arm and left side of chest; the left hand was cold, cyanotic and weak. Operation was advised against on the ground that the symptoms were not proportional to the dangers of operation.

November 6, 1921: Readmitted. Operation November 29, 1921. Infection, swelling necrosis and hemorrhage demanded intervention, but high brachial amputation was the only possible operation.

The patient recovered from this, and the local symptoms in the arteriovenous aneurysm improved.

Abstract No. 4. Laspuir's case.[17] Boy of nineteen years received a bullet wound 1½ inches below center of left clavicle. Pain, weakness of left arm and large aneurysmal tumor developed.

Operation, five weeks after the injury: Chloroform. Clavicle resected, tumor exposed, artery clamped, incised and clot turned out; quadruple ligation and excision of vessels with fistule. Clavicle replaced. Drained for forty-eight hours. Full recovery.

Abstract No. 5. Reid's cases.[18] Reid reports in this collection of cases, four arteriovenous aneurysms of the subclavian vessels. Two were treated with successful outcome, by quadruple ligation and excision of the fistula; one by ligation of the fistulous tract; and the fourth, while waiting for such a time as the development of a collateral circulation might be expected to have taken place, underwent spontaneous healing.

Abstract No. 6. Constant's case.[19] Man of twenty-one, pistol wound of right supraclavicular region, July 6, 1925. Six days later pyohemothorax developed which was relieved by costal resection and drainage.

On August 13 a tumor was found above the clavicle. A diagnosis of aneurysm was made and ligation of the axillary artery was carried out as a step preliminary to operation.

September 25, operation. Ether anesthesia. Sternoclavicular joint was separated and clavicle was retracted. The external jugular and subclavian veins and the subclavian artery were ligated and the tumor was excised; clavicle replaced.

Complete recovery, with some diminution of strength of left arm.

Abstract No. 7. Haberer's case.[20] Patient sustained, in 1914, a gunshot wound of left posterior scapular region with exit in region of the left sternoclavicular joint.

A tumor immediately appeared in the left cervical region. He was operated on for the severe pain, but no record could be obtained as to what was done. After a year in hospital he was capable of light work, but soon began to suffer with cerebral symptoms: unconsciousness, blackness before the eyes, buzzing and "knocking" in the head.

When seen eleven years later, these symptoms were aggravated, and there were also noted thrill and bruit. The bruit was very marked at the upper thoracic aperture and over the entire left side of the skull.

The diagnosis was arteriovenous aneurysm of carotid artery and jugular vein or of subclavian vessels, with the latter diagnosis less likely than the former.

Operation. November 17, 1925.

Entire clavicle removed: The carotid was found to be intact. The left innominate, left internal jugular and left subclavian veins were ligated. The sac of the aneurysm ruptured during the manipulations and severe hemorrhage occurred. This was completely controlled when the subclavian was secured with ligature. The distal end of the subclavian artery had evidently been ligated at the first operation, as no ligature was applied and no hemorrhage from it occurred at this operation. The sac was extirpated, and a broad communication was found between the subclavian artery and the left innominate vein.

A drain was left in the wound for forty-eight hours, and healing proceeded without interruption.

Postoperative complications were pleuropneumonia, which disappeared in a short time, some evidence of disturbance of the vagus nerve (hoarseness) and some sympathetic disturbance.

The symptoms and signs previously present over the chest and skull disappeared immediately. After three and one-half months' stay in the hospital he was discharged in good health and was able to return to work.

Abstract No. 8. Holman's case.[21] Patient received a bullet wound just above the mid point of the right clavicle on October 22, 1922.

On admission to Johns Hopkins Hospital on November 29, examination revealed a pulsating tumor in the supraclavicular fossa. A thrill and bruit were noted; Branham's sign and blood pressure changes could be demonstrated by deep pressure above the clavicle. There was no cardiac enlargement.

Diagnosis: Varicose aneurysm of subclavian vessels.

Operation: Resection of the middle two-thirds of the clavicle. The clavicle showed some erosion, and proved to form part of the wall of the sac. The aneurysm ruptured at this point, and hemorrhage was controlled by pressure with the thumb until the innominate and common carotid arteries could be secured with provisional ligatures. The innominate was tied and deep silk sutures were placed which probably occluded the subclavian vein. The wound was closed without drainage. On two occasions small openings were made in the line of incision to evacuate old fluid blood.

Complete recovery with slight weakness in the arm.

Abstract No. 9. Pemberton's case.[22] A case of arteriovenous aneurysm of left subclavian vessels resulted from a gunshot wound. He was operated on May 29, 1916. The fistulous tract was obliterated by ligation. This resulted in cure. Report ten years later showed that the strength was all right and that his condition was satisfactory. A time of operation slight cardiac enlargement was noted.

Abstract No. 10. Gilcreest's case.[23] December 12, 1920, patient received a gunshot wound, entering the right chest at the third costochondral junction, with wound of exit in supraclavicular region. When seen eight years later, there was enormous swelling of the right chest, shoulder, arm and hand, with great venous dilatation. Cardiac dilatation and hypertrophy were present, together with characteristic thrill and bruit.

First Operation, November 5, 1927. Local infiltration anesthesia followed by nitrous oxide and ether. Inner two thirds of the clavicle resected. The innominate, external jugular, subclavian, internal jugular veins, and the subclavian artery in its first portion were ligated. Wound closed without drainage.

Much improvement followed.

Second admission, August 6, 1928. Slight return of swelling in right arm, small ulcer on right forearm; thrill above clavicle.

Second operation, August 10, 1928. Nitrous oxide anesthesia. The regenerated clavicle was resected. The axillary, long thoracic and subclavian veins, and the axillary and long thoracic arteries were ligated. Closure without drainage. Serious slight discharge from the wound was noted on a few occasions.

Cure resulted.

Abstract No. 11. Benedetti's case.[24] January 25, 1919, patient was shot in the left subclavicular region. Thrill appeared a few hours after the

injury, and he suffered from pain in arm, sensory disturbance in the course of the ulnar nerve, edema of hand and incapacity in use of arm.

Diagnosis: Arteriovenous aneurysm of left subclavian vessels.

Operation. April 24, 1919. Chloroform anesthesia.

Clavicle resected; subclavian artery ligated outside the scaline; axillary artery ligated; sac the size of a lemon was found. The subclavian was ligated above and below the sac and the whole tumor excised. Closure with drainage, after replacing the clavicle.

Wound healed without infection and a complete cure was effected.

Abstract No. 12. Magniel's case.[25] Patient was injured in lower right scapular region by a shell fragment in 1917. After the wound healed he resumed his sedentary occupation without functional disturbance other than dyspnea on unusual exertion.

Recent examination (report is made in 1932) reveals: Fine network of collateral circulation at level of right deltoid region: slight intermittent fremitus in right subclavian region; rough murmur at the same level; no noteworthy modification of arterial pressure, and no evidence of cardiac inefficiency.

Diagnosis: Arteriovenous aneurysm of right subclavian vessels.

X-ray was then taken and revealed in the right ventricle a rectangular projectile 1 cm. square which was whirling about rapidly.

He advises against any attempt to remove the shell fragment, and thinks, in view of the fact that the arteriovenous aneurysm has been present for fourteen years without evidence of material damage, that no surgical intervention should be undertaken unless special symptoms arise.

Abstract No. 13. Curti's case.[26] Patient injured by a shell fragment under the middle of the right clavicle; remained in hospital two months. Was seen sometime after the injury and presented enormous increase in size of right arm and shoulder; dilated, tortuous, and slightly pulsatile veins; thrill in supraclavicular and subclavicular regions, murmurs, and a rough systolic-diastolic murmur of such intensity in the supraclavicular fossa that it could only be compared to the sound made by a train rushing over an iron bridge. The pulse was rapid and he complained of deafness, roaring in the ear, fatigue, and giddiness when walking rapidly. It was evident that there was a dilatation of the aortic orifice. The radial pulse and the blood pressure on the affected side was much weaker and lower than on the uninjured side.

The diagnosis was arteriovenous aneurysm of right subclavian vessels.

The use of iodogelatin resulted in diminution of edema of the hand. The author doubted whether, on account of the elephantiasis of the arm and the size of the sac, one could extirpate the sac or amputate the arm.

Abstract No. 14. Matas's cases.[27]

I. Richard S., stab wound left side of neck, Aug. 15, 1915. Large pulsating hematoma filled axilla and caused bulging in pectoral region. Thrill and murmur were present and were characteristic of arteriovenous aneurysm.

Operation September 7, 1915, Ether. Matas-Allen aluminum band applied to the left subclavian artery at its exit from the scaline. The communication was at the terminus of the subclavian vessels.

The effect of the bank was to still the pulsations, thrill, and murmurs completely and to reduce the size of the tumor.

Nothing further was done. Complete cure.

II. James S. received a gunshot wound on March 7, 1921, which resulted in an arteriovenous fistula of the second division of the left subclavian vessels in the second division, complicated by a brachial plexus injury.

Operation May 30, 1921 under local and regional anesthesia. Clavicle resected; artery and vein were exposed outside the scalines; vein clamped on each side of the fistula; artery controlled by rubber bands; vein opened freely to expose the fistula. The opening in the artery was closed by transvenous suture and the vein segment was removed. On removing the rubber bands, the circulation in the artery was at once restored, and the radial pulse returned.

Complete cure followed. This is the first reported case of arteriovenous fistula of the subclavian vessels cured by transvenous suture.

III. Mrs. M. P. W. developed arteriovenous aneurysm of the right subclavian vessels when a glass splinter from a broken windshield penetrated her neck.

Operation five months later, February 4, 1924, under local and regional anesthesia. Ligation of thyroid axis and its branches and satellite vein; no lesion of the main trunks was found. Suppression of thrill and bruit until twelfth day, when the murmurs returned but in a very subdued form. The glass fragment could not be found and the precise seat of the anastomosis could not be determined, except that the suppression of the thyroid axis arrested all signs of aneurysm, indicating that the anastomosis existed between some of the smaller branches of the axis. By April 12, 1924 the thrill and bruit were scarcely perceptible and she had resumed her work as a nurse.

IV. E. R. developed an arteriovenous aneurysm of the right subclavian vessels at the junction of the second and third divisions. Operation October 13, 1924, under local and regional anesthesia.

Inner half of clavicle excised; exposure of the subclavian throughout its length; circulation controlled by provisional traction ligatures on innominate artery and at various levels on the subclavian artery up to the seat of

the fistula and also on the distal side of the fistula; arteriovenous communicating channel excised; artery above and below fistula ligated and divided between the ligatures; the attachment of the channel at its opening into the subclavian vein was ligated when the channel was excised.

Primary wound healing and patient returned to normal occupation.

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[For Discussion see article by Dr. Singleton.*]

*This will appear in the June issue of the Journal.

ACUTE INTESTINAL OBSTRUCTION

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FIFTH INSTALLMENT

PART I: THE DISEASE

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Chapter XI

THE CLINICAL AND PATHOLOGICAL PICTURE

Morbid Anatomy

Turning now to the local changes produced by obstructions, we will consider first those that take place under conditions of simple obstruction, and later the special changes found when the obstruction has been complicated by interference with the blood supply.

Simple Obstructions. The pathological changes in the intestine following simple obstructions vary with the duration of the illness and the lesion causing the obstruction. In general, the longer the obstruction has persisted the more marked are the changes. Many of the more serious degenerative changes are the result of distention, which interferes with the circulation to the bowel wall.* This does not appear at once, since an appreciable length of time must usually elapse after the onset of obstruction before the distention becomes of sufficient importance to impair the blood supply.

The coils of intestine above the obstruction are dilated; those below collapsed. In the later stages the blood vessels over the surface show evidence of hyperemia and congestion; there is frequently a definite bluish, cyanotic tinge, indicating capillary and venous stagnation. The intestinal walls may show evidence of congestion and edema; at times they may be distended to almost paper thinness. The mucosa usually shows evidence of intense congestion and edema and is swollen and purplish-red in color; small hemorrhagic areas may be found. The wall is often extremely friable and must be handled with the greatest circumspection to avoid a tear or perforation. Hartwell, Hoguet and Beekman[1] have studied very carefully the changes in the intestinal wall following simple obstruction in dogs. In general, the lesions they described were congestion,

*See January installment, p. 185.

hemorrhagic areas and areas of superficial necrosis. (See also Braun and Wortmann.[2])

These lesions are often all that can be demonstrated in the intestinal tract in uncomplicated, fatal cases of obstruction; and at times even these cannot be found. Elman and Hartmann[3] in over half of their experimental obstructions were not able at autopsy to demonstrate lesions in the bowel wall. Carlson and Wangensteen[4] also reported only slight changes: congestion and edema. At times, however, extensive lesions may be found. The distended bowel may show ulcers due to interference with the circulation of the bowel resulting from distention (Bryant,[5] Kocher,[6] Morison,[7] Van Beuren[8]); Van Beuren stresses the importance of the time factor in the damage caused by distention. The ulcers may progress to actual perforation. These changes are most often seen in their extreme form in distention of the cecum and may progress to extensive areas of gangrene and perforation. Extensive local changes in the bowel wall take place at the actual point of obstruction: for instance, a band passing over the bowel wall may produce pressure ulceration at the point of contact. In the area where a gallstone has become impacted there may also be areas of pressure necrosis. Experimental studies[1] have shown that even very localized damage to the bowel, as, for example by a constricting ligature, may be an important factor in the clinical course of the obstruction. (Further discussion will appear in a later chapter.)

In cases where an acute obstruction is superimposed upon a chronic stricture, extensive inflammatory changes may be found above the obstruction, causing catarrhal or phlegmonous ulceration. This type of ulceration, according to Kaufmann,[9] is due in some cases to distention, in other instances to toxic necrosis from the chemical effect of stagnating feces and the secondary bacterial action. Kaufmann mentions cases in which obstructing, stony-hard scybala have produced ulcers which were actual imprints of fecal masses. These ulcers are due to anemia brought on by local pressure; and the disintegration may go

on to perforation. The bowel wall above a stricture that has persisted for some time may show marked hypertrophy, dilatation and inflammatory reactions. A detailed account of these changes is given by Treves.[10]

Intestinal Contents. The contents of the bowel, if the obstruction is in the small intestine, is usually the thin, brownish, foul-smelling fluid commonly designated "fecal" vomitus. The amount of gas present varies in different cases; it is usually abundant in obstructions of the large intestine.

Normally, few bacteria are found in the stomach, duodenum and upper jejunum (Cushing and Livingood,[11] Herter[12]). The ileum contains a diverse flora of potentially pathogenic bacteria, embracing a large number of different types of anaerobic as well as of aerobic organisms (Herter), the numbers becoming more numerous as the ileocecal valve is approached. The colon, of course, always contains enormous numbers of organisms. Among the anaerobic organisms that may normally be present in the intestine, Herter mentions B. putrificus. B. aerogenes capsulatus, B. sporogens, B. tetani, and B. histoliticus have also been mentioned (Williams[13]).

On the basis of the fact that few bacteria have been reported as occurring normally in the stomach, duodenum and upper jejunum, it has been assumed by some writers that this holds under conditions of obstruction. This is by no means true: the fluid above the obstruction contains enormous numbers of organisms regardless of whether the obstruction is located high or low in the intestinal tract. It has been shown (Cannon, Dragstedt and Dragstedt[14]) that the intestinal flora following obstruction becomes dominated by the proleolytic types of bacteria. Williams has stressed the great increase in the numbers of B. welchii that will ordinarily be found in the contents of obstructed loops, and this has been confirmed by McIver and others.[15]*

* This organism is not always found, however. Recently, anaerobic cultures of the loop contents from a patient acutely ill with high obstruction showed no gas-producing bacilli.

STRANGULATIONS. The mechanism of strangulation has already been discussed.† The pathological changes that are found in the bowel wall depend upon a number of factors, of which the more important are the completeness of the interference with the circulation and the time that has elapsed since the onset of the obstruction. Due to the thin walls of the veins and their low internal pressure, interference with the venous return occurs quickly. The bowel wall soon shows evidence of the venous stasis: the color changes to a dusky, mahogany red, which turns to black as the venous occlusion becomes more complete. As the blood supply fails, a violent and disordered type of peristalsis has at times been noted.[16] The lumen of the intestine becomes distended with a bloody fluid exudate containing a large amount of particulate matter, largely blood cells and bacteria. The fluid that rapidly accumulates in the peritoneal cavity is also blood-stained, a finding which furnishes valuable evidence of strangulation in exploratory operations for intestinal obstruction.

If the strangulation is not relieved, the changes rapidly progress to actual gangrene of the intestinal wall. The mucosa is the first structure to show the disintegrative effects, and in complete venous occlusion these can occur very early (Murphy and Vincent[17]). With the necrosis of the mucosa, an important barrier to bacteria has been destroyed, and a rapid infiltration of the walls by microorganisms occurs. The appearance of the gangrenous loop is characteristic: the peritoneal surface loses its normal sheen, becoming dull and lusterless; it may show a thin layer of grayish fibrin over the surface, often binding the affected loop lightly to the surrounding loops or to the parietal peritoneum; thrombosis of the involved mesenteric vessels may often be demonstrated. All tone in the muscular structure is lost and the wall feels pasty and doughy. Perforation may occur, with a resulting diffuse peritonitis; or peritonitis may appear without a macroscopic perforation.[18]

† See January installment p. 195.

The pathological changes occurring in the bowel in intussusception and mesenteric thrombosis have already been discussed.

Peritoneal Cavity. In the early stages of simple obstructions there is usually an increase in the amount of free peritoneal fluid. Where strangulation is present this fluid is likely to be blood-stained. After degenerative changes have occurred in the bowel wall, peritonitis is a relatively frequent complication. This may be due to a gross perforation in the obstructed bowel; or, where gangrene is present, the intestinal wall may be so permeable to bacteria that peritonitis occurs without a gross perforation. Some degree of peritonitis is a common finding at autopsy in patients dying of obstruction. This is particularly true of those dying after operations which involve openings into the bowel: it is not easy to avoid soiling the peritoneal cavity with the highly septic contents of the bowel; and there are a certain number of cases where in attempting to free an adherent loop the friable bowel wall gives way and some of the contents is spilled: a most serious accident. Among 123 autopsies of obstruction cases at the Massachusetts General Hospital, general peritonitis was listed as the principal or contributing cause of death in 66 instances.

Pulmonary Lesions. A pneumonic process in the lungs may be found at autopsy either as a terminal manifestation of the disease or resulting from the aspiration of septic vomitus at operation. In the latter case, if the patient survives long enough, the process may go on to lung abscess or gangrene.

The following quotation from Leichtenstern[19] is of interest:

> We have yet to mention briefly a lesion which is found in the lungs of those who have succumbed to ileus. I refer to pneumonia caused by the presence of foreign bodies in the lungs, particles of vomited matter (fecal matter, when the vomiting is stercoraceous) carried in during inspiration. This can occur the more easily as the patients are often rendered comatose by large doses of opium and the reflex irritability of the mucous membranes of the respiratory passages is diminished. Like most pneumonias of this kind, they occupy mainly the lower or middle lobe of the right lung, where infiltrations (sometimes distinct lobular ones, sometimes united in forming lobar ones) are found with a dirty-gray or dark green surface on section,

central sphacelated softening, and formation of gangrenous cavities filled with the offensive matter. The surrounding lung tissue is more rarely in a condition of hepatizing inflammation than in that of soft, moist infiltration. Microscopical examination of the gangrenous spot clearly shows, as I have occasionally demonstrated, that aspiration of the contents of the intestines has taken place, for we find there pieces of muscle stained with bile, bits of vegetables, grains of starch, etc. (Leichtenstern, 1876.)

Among the 123 cases of acute intestinal obstruction autopsied at the Massachusetts General Hospital, serious pulmonary complications existed in 29 instances, as follows:

Bronchopneumonia	16
Lobar pneumonia	2
Lung abscess	1
Lung abscess with empyema	1
Gangrene and abscesses of the lung	1
Gangrene of lungs	2
Edema of lungs	4
Pulmonary embolus	2

NERVE LESIONS IN THE CELIAC GANGLIA. Changes have been reported by Myerson[20] as occurring in the nerve cells of the solar plexus in a case of volvulus; the chief changes found were a disappearance of the Nissl bodies and an abnormal location of the nucleus.

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Chapter XII

THE CLINICAL AND PATHOLOGICAL PICTURE
(Continued)

General Findings

We will now consider the more general bodily changes produced by intestinal obstruction.

Temperature. In general, it may be said that intestinal obstruction does not produce marked changes in body temperature unless some complication is present. In the early stages of simple obstruction the temperature is usually normal or only slightly elevated; it may be subnormal. Later in the disease there may be a slight fever, probably due to infection around the point of obstruction. In obstructions by strangulation, a high temperature will occasionally be found late in the course of the disease; in such cases there is usually considerable peritonitis in the region of the involved loop. Following operations for intussusception in children and infants a marked rise in temperature may occur, even though no peritonitis be present[1]; the cause for this reaction is not clear. In rare instances where there is infarction of extensive portions of the intestine there may be a subnormal temperature.

Respiration. In the early part of the disease some quickening of respiration is caused by pain sensations. In the later stages the respirations are usually rapid and shallow: Braun and Boruttau[2] considered that this was a manifestation of anemia of the respiratory center due to low blood pressure, and regarded the damage to this vital center as an important factor in a fatal outcome.

Circulatory System. *Pulse.* At the onset of all types of the disease there is likely to be some increase in heart action, shown by the accelerated pulse. This would be expected to accompany the acute pain, and probably represents increased

stimulation of the heart by way of the sympathetic accelerator fibers.* After the initial stages, the pulse may return to normal, particularly if the pain has been controlled by morphine; although in cases of strangulation at least a slight elevation of pulse rate is likely to continue. It may be said in general that if the disease progresses in an unfavorable manner there is an accompanying increase in the pulse rate; but, as pointed out by Eisberg,[3] one should not be deceived as to the seriousness of the situation by the fact that the pulse is of normal rate and good quality, for its character may not be affected until late in the disease and then may rather suddenly become rapid and thready. Cases of mesenteric thrombosis have been reported[4] where the pulse rate was strikingly slow early in the disease.

Blood Pressure. It is generally agreed that in the early stages of obstruction there are usually no marked changes in the arterial blood pressure. Frequent reference will be found in the literature[5] to the collapse that accompanies the onset of acute obstruction; but I know of no report of low blood pressure shown by such patients; Tileston and Comfort[6] are among the few authors who have recorded blood pressure readings on patients, and their data are meager. It seems likely that when early collapse does occur it is in the nature of prostration from acute pain and is not accompanied by the low blood pressure associated with true shock; exception to this statement may be found in instances of extensive infarction or strangulations which involve considerable portions of the intestinal tract.

In the terminal stages of obstruction there is a progressive fall in the systemic blood pressure. Most writers regard this merely as one manifestation of a toxemia that is bringing about a suspension of all the vital processes. Braun and Boruttau,[2] however, believe that the fall in blood pressure is of primary importance; they attribute to this the other signs of collapse, and consider that most of the other serious effects of the

* Sweating is another evidence of sympathetic activity often noted at this time.

disease may be considered as secondary to the resulting anemia. The objection to this view is that since the fall in blood pressure usually occurs late in the disease, it is difficult to see how it can be regarded as in any way primary. It is obvious that once the blood pressure has fallen to a low level, very serious secondary effects may promptly follow, the patient passing into a depressed state resembling in many respects that seen in traumatic shock.

Accompanying the fall in systemic blood pressure there is evidence of capillary stasis, as shown by the grayish or dusky pallor exhibited by patients with obstruction as the end approaches.

Blood Cytology. Usually little change in the red blood cells is produced by intestinal obstruction. If the concentration of the blood is marked, there may be a relative increase in red blood cells. Considerable variation, on the other hand, may be shown by the white blood cells. If the obstruction is a simple one, the white count is usually normal; occasionally there may be some elevation, due probably to infection in the region of the obstruction. If strangulation is present the count is usually elevated and is likely to go higher as the disease progresses. The ratio of polymorphonuclear leucocytes is usually increased. Cases of mesenteric thrombosis are likely to show a striking elevation of the white blood cells.

Blood, Bacteriology. It is generally agreed that bacterial invasion of the blood stream does not occur except as a terminal phenomenon.

Blood Chemistry. The changes which may take place in the chemical composition of the blood plasma during obstruction are so important that they are given a separate chapter.

KIDNEYS. That intestinal obstructions are accompanied by a diminution in the secretion of urine often amounting to anuria was known to the early observers (Leichtenstern,[7] Brinton,[8] and Nothnagel[9]). This suppression of excretion was attributed by these early workers in part to dehydration and in part to a reflex inhibition of kidney secretion; they applied

this latter explanation particularly to those cases of strangulation where diminished secretion of urine accompanied the onset of the attack.

It is only comparatively recently that careful investigations of the disturbance of kidney function caused by intestinal obstruction have been carried out. In 1914, Tileston and Comfort,[6] while investigating the non-protein nitrogen and urea of the blood in a number of diseases, studied 3 cases of acute intestinal obstruction and found a great increase in both of these constituents; the volume of the urine was small and showed albumin and casts. McQuarrie and Whipple[10] studied this subject in more detail in relation to intestinal obstruction, and showed that there was a great increase in urinary nitrogen and a marked increase in non-protein nitrogen of the blood; they also reported a decrease in kidney excretory function, as shown by the inability of the kidney to excrete the normal amounts of urea, sodium chloride and phenolsulphonphthalein. Along with this they reported a decrease in the output of fluids.

That a serious disturbance of kidney function, or at least a decreased secretion of urine and a heaping-up in the blood of nitrogenous products, accompanies intestinal obstruction has been abundantly confirmed by all later workers (Haden and Orr,[11,12] Gatch et al.,[13] Gamble and McIver,[14] and others); there has been, however, a difference of opinion as to the mechanism of this impairment of the kidney function. Hartwell, Hoguet and Beekman,[15] and later Brown, Eusterman et al.,[16] have reported degenerative lesions of the kidneys in association with upper intestinal obstruction. Most of the workers, however, have not been able to demonstrate organic lesions of the kidney. McQuarrie and Whipple[10] believe that although they could find no anatomical lesion, the impaired function is due to the direct action of a toxic substance upon the renal epithelium. Marriott and others,[14,17] on the other hand, believe that no injury to the kidney exists but that under conditions of dehydration this organ is not able to function

properly; in other words, it cannot separate a normal urine from concentrated blood. This explanation of decreased kidney function would seem to be the most reasonable, at least in those cases showing dehydration, and would account for the prompt return to normal under appropriate treatment.

LIVER. The function of the liver under conditions of intestinal obstruction has not been extensively investigated. That there may be serious disturbance was suggested by Werelius,[18] chiefly on the basis of the fact that he observed in his experimental animals a marked decrease in the flow of bile following the production of upper intestinal obstruction. Colp and Louria,[19] however, not only were unable to confirm this observation but found that the liver function as determined by the phenoltetrachlorphthalein method was normal; they were, moreover, unable to demonstrate any structural changes in the liver. Haden and Orr's studies[12] on the fibrin content of blood following obstruction do not support the idea that liver insufficiency plays a rôle in intestinal obstruction. Werelius's belief that there is serious disturbance of liver function thus requires further proof.

BASAL METABOLISM. Disturbances of the basal metabolic rate have not been recorded in intestinal obstructions. Presumably when the terminal shock-like state is reached the metabolism is depressed, as it is in traumatic shock (Aub[20]).

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Chapter XIII

THE CLINICAL AND PATHOLOGICAL PICTURE
(Continued)

Changes in Body Fluids

Important changes frequently occur in the composition of the blood plasma following intestinal obstruction, the more important being a *decrease in the chlorides* and an *increase in the alkali reserve* and a *rise in the non-protein nitrogen.* Along with the chemical changes, a marked degree of *dehydration* may occur.

The fact that patients with intestinal obstruction frequently give evidence of extreme loss of water was familiar to the early writers, Barlow,[1] Brinton[2] and Leichtenstern.[3] The last named author mentions dryness of the mucous membranes and skin, intense thirst, choleraic face and voice, sunken eyes, cramps in the calves of the legs, and anuria. All of these symptoms, he states, point to a rapid withdrawal of water from the blood; and this he considers due to vomiting and profuse sweating. These changes are most typical and pronounced in simple high obstruction; but they may also occur in low obstruction if the vomiting is profuse and continues over a period of several days. They are rarely found in the type of obstruction characterized by strangulation, because in such cases the whole course of the disease is likely to be too short for extensive loss of fluid by vomiting.

Closely associated with the loss of blood chlorides and, as a rule, proportionately increasing as the chlorides are lowered, there is, as stated above, an increase in bicarbonate or alkali reserve. This represents an important adjustment in the blood, tending to maintain the normal reaction in the face of the large loss of the acid radical, chloride. The literature bearing on the lowering of the blood chlorides in intestinal

obstruction may here be briefly reviewed. In 1912, Hartwell and Hoguet[4] showed that dogs with high intestinal obstruction (simple blockage of the bowel) could be kept alive for several weeks if given, by subcutaneous injection, large quantities of salt solution. Unless so treated, the animals died within four to six days. They believed that the efficacy of this measure consisted in sustaining the water content of the body, and advanced the theory of dehydration as the cause of the symptoms in this type of intestinal obstruction. In 1920, MacCallum and his co-workers[5] showed that in experimental pyloric obstruction the blood chlorides are lowered and the alkali reserve is increased. In 1923, Haden and Orr[6] also found a lowering of blood chlorides in high intestinal obstruction, and confirmed Hartwell's experiments demonstrating the efficacy of salt solution in prolonging the life of animals. Since their first contribution to this subject, Haden and Orr, in numerous investigations and clinical studies, have stressed the importance of the lowering of the blood chlorides; and it is largely due to their efforts that the medical profession has been convinced of the great importance of this finding and the value of instituting appropriate treatment. In their earlier papers, these authors advanced the theory that the reason the chlorides were lowered in the blood was that they were withdrawn from the plasma to neutralize some toxin absorbed from the obstructed intestine. In their later publications, however, they modified their opinion on this point, coming to agree with Gamble and McIver,[7] White and Bridge,[8] Atchley and Benedict[9] and others, who contend that the decrease of chlorides is due to their loss in the digestive secretions by vomiting.

Mechanism of Dehydration. In papers appearing in 1925, Gamble and Ross,[10] and Gamble and McIver[7] regarded the loss of sodium and chloride ions as largely responsible for the fatal effects of high intestinal obstruction; for, while agreeing with Hartwell and Hoguet[4] that death in this type of obstruction was due to dehydration, they considered the

dehydration the result of the loss of these electrolytes, using here the general physiologic concept that the volume of a body fluid is sustained by its total ionic content. The substances

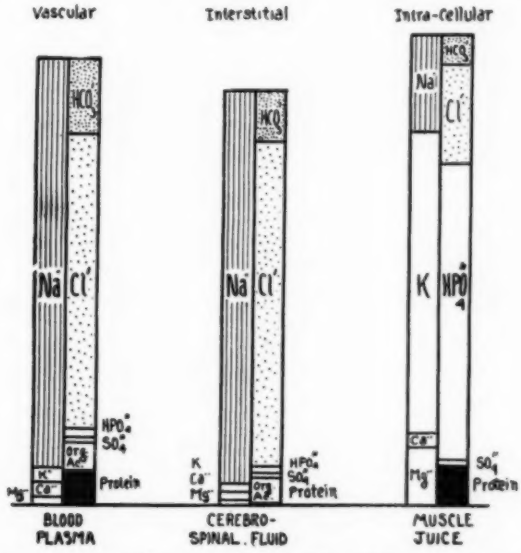

FIG. 37. Acid-base composition of body fluids. This diagram is constructed from average values for individual factors expressed in terms of acid-base equivalence: i.e., as cubic centimeters of tenth normal solutions per 100 c.c. of fluid. Base factors are superimposed in left hand and acid factors in right hand of each column. They represent, as is actually the case, a structure composed not of salt but of individually sustained concentrations of ions. Exact acid-base equivalence indicated by equal height of two parts of each column is obtained by adjustability of bicarbonate ion concentration (HCO_3) to any change elsewhere in structure. (McIver and Gamble[13])

which are of chief importance in supporting the volume of the blood plasma and of the interstitial body fluids are sodium and chloride ion. The reason for this is, simply, that these two substances are quantitatively the chief factors in the total ionic content of these fluids, as may be seen by reference to the diagram describing the acid-base composition of the body fluids given in Figure 37.[11] It may be noted that, according to the third column in this diagram, sodium and chloride ion are present in relatively small amounts in intracellular water. The significance of this fact will be referred to presently. That these two substances are also the chief inorganic factors in the composition of the digestive secretions is shown by

Figure 38. This diagram is constructed from data obtained from specimens of digestive secretions collected from animals by the methods of Pavlov and others.[12] The total fixed base in

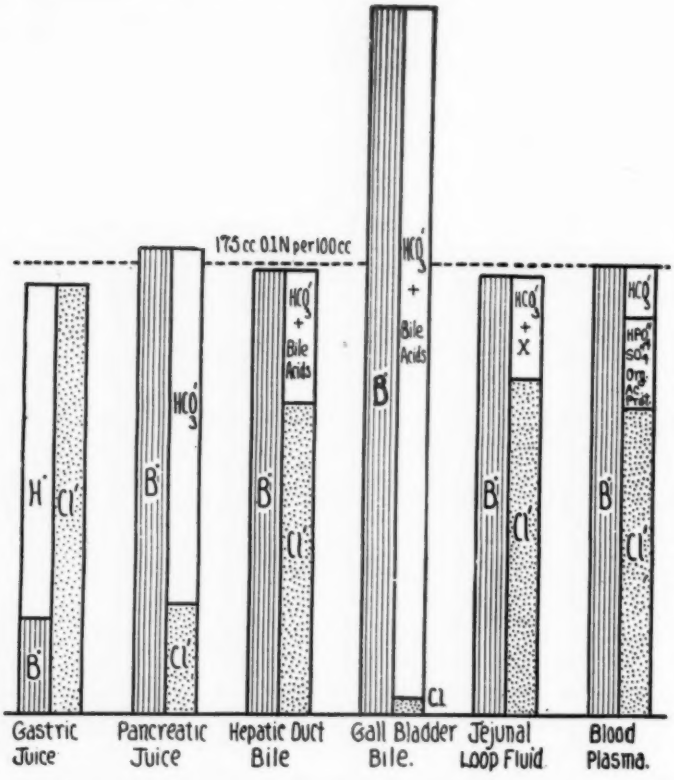

FIG. 38. Acid-base composition of digestive secretions. As in Figure 37, this is constructed from measurements of component factors expressed as cubic centimeters of tenth normal per 100 c.c. of fluid, base factors being superimposed on left hand and acid factors on right hand of columns. Pancreatic juice data from dog; other data from cats. (McIver and Gamble[13])

these secretions (B in Figure 38) is, as in the case of the blood plasma, composed almost entirely of sodium. A diagram of the composition of the blood plasma (of the cat) is also included in order to make clear the fact that the digestive secretions contain fixed base and chloride ion in amounts which are appreciable in terms of the plasma content of these substances. The inorganic substances in the digestive secretions are, of course, derived from the plasma. Under ordinary

circumstances they are in great part returned to the plasma following the periods of digestive activity, and there is also abundant replacement from the food intake. Evidently, if there is interference with their reabsorption, as is the case in the presence of pyloric or high intestinal blockage, a continuous loss from the blood plasma will occur. According to the conception which is here being used, the consequent depletion of the total ionic content of the plasma and of the interstitial body fluids will be accompanied by an approximately parallel loss of water with the result that a normal total ionic concentration tends to be sustained at the expense of reduction of volume. That is, dehydration is regarded as the result of the loss of electrolytes; and an important corollary of this view is that dehydration cannot be repaired by the administration of water alone: an attempt to restore and sustain the original volume of the blood plasma and of the interstitial body fluids must include replacement of the lost electrolytes. An additional theoretical point has been brought out by Gamble and Ross;[10] viz., that loss of sodium rather than loss of chloride ion is the significant factor in determining the extent of dehydration, since the loss of chloride ion is compensated for within the body fluids by a corresponding increase of bicarbonate ion.

Extent of Loss of Water and of Electrolytes in Digestive Secretions. The enormous volume of the digestive secretions which in the course of twenty-four hours normally enters the upper part of the gastrointestinal tract and is reabsorbed from the lower bowel is usually not appreciated. From the data which Rowntree[14] has collected from various sources, it may be estimated that for an adult the secretion of digestive fluids, taken together, amounts to between 5 and 7 liters daily. This is two or three times the volume of the blood plasma which is the immediate source of these secretions.

It has been shown that circumstances causing severe dehydration may reduce the volume of the blood plasma by one third.[15] This finding by no means indicates the actual extent

to which water and electrolytes have been withdrawn. It has been found that, following experimental pyloric and duodenal obstruction in rabbits, several times the total initial plasma content of water, of fixed base and of chloride ion enters the stomach during the survival period, as shown in Table XII. A rapid and extensive replacement of water and of electrolytes is thus indicated. The immediate source of these materials is the interstitial body fluids. Reduction of the volume of these fluids provides the familiar clinical evidences of dehydration, i.e.: dryness of the skin, shrinkage of the subcutaneous tissues and, in infants, deep recession of the fontanels. It is probable that intracellular body fluids are only to a slight extent drawn upon, for the reason that these contain relatively small amounts of the electrolytes, sodium and chloride ion, particularly required for plasma repair (Figure 37, column 3, showing composition of muscle juice).

Obviously, this arrangement defends cell volume; and direct measurements of the water content of parenchymatous tissues from severely dehydrated animals have shown an extremely small loss. The data in the accompanying table will serve to emphasize the great importance of the quantitative aspect of therapeutic attempts. They show that a considerable part of the body's content of water and of sodium and chloride ion may be rapidly lost. When similar circumstances are encountered clinically, replacement measures should be correspondingly extensive and sustained.

CHANGES IN THE BLOOD PLASMA CAUSED BY LOSS OF DIGESTIVE SECRETIONS. *Concentration Changes Due to Loss of Water.* As a result of the reduction of the volume of the blood plasma there occurs, as might be expected, an extensive increase in the concentration of plasma protein, and a rise in the red count and hematocrit reading. That loss of water from the plasma causes physical changes in the blood, increase of viscosity, for example,[16] which must seriously interfere with its respiratory and other functions, is shown by the fact that in severe dehydration a tenfold reduction

of volume flow may occur.[17] Haden and Orr[18] have recently shown a huge reduction of the oxygen content of venous blood in the presence of high obstructions.

Changes of Acid-Base Structure Due to Loss of Sodium and Chloride Ion. The important change to be here considered is a change in the reaction of the plasma due to alteration of the bicarbonate concentration, and this in turn is referable to the relative amounts of sodium and of chloride ion withdrawn from the plasma. The latter relationship may be briefly explained with the help of Figures 37 and 38. In Figure 37 it may be seen that the sum of the acid factors in the plasma is represented as exactly equivalent to the total of fixed base. This equivalence is maintained in the presence of changes in the individual factors, by the adjustability of the bicarbonate ion concentration. In Figure 38, column 1, the composition of gastric juice, chloride ion is seen to be in large excess of fixed base.[12] Withdrawal of these substances from the plasma in the proportions indicated in this diagram may be expected greatly to decrease the extent to which fixed base in the plasma is covered by chloride ion; and to this extent the bicarbonate ion concentration will be increased. Actually it has been well established that continued loss of stomach secretions following experimental obstruction of the pylorus does produce an alkalosis, often of a degree sufficient to cause severe tetany. The columns representing the inorganic factors in pancreatic juice and in gall-bladder bile[19] show that, in complete contrast to gastric juice, these secretions contain fixed base in much greater amounts than chloride ion. The inference is thus provided that loss of these secretions will tend to reduce the plasma bicarbonate. This expectation has been verified by finding a marked degree of acidosis, as measured by bicarbonate reduction, in the blood plasma of a dog following construction of a pancreatic fistula which completely drained away the external secretion.[20]

In the presence of upper intestinal obstruction there is obviously opportunity for loss of all these digestive secretions.

The accompanying change in plasma bicarbonate has been found to be widely variable: usually there is an extension, which is often large; occasionally there is no appreciable change from the normal value, and infrequently there is a considerable reduction. According to the foregoing discussion, this variability of plasma bicarbonate is understandable as the result of differences in the relative amounts of stomach and of duodenal digestive secretions which have been lost, loss of the former tending to produce alkalosis and of the latter, acidosis.

Besides the loss of gastric juice, of pancreatic juice and of bile, it is quite likely that another factor is present: viz., loss of fluid derived from the intestinal mucosa. The probable composition of this fluid is indicated by the analysis of a specimen drained from an isolated upper jejunal loop, which is represented in Figure 38. There is some doubt as to whether this fluid should be regarded as an irritatively stimulated digestive secretion or as an exudate. In any case, however, it is seen to contain approximately the same amount of fixed base and of chloride ion as does the blood plasma. Loss of this fluid will cause reduction of the volume of the blood plasma and of the interstitial body fluids, but should not alter the plasma chloride (or bicarbonate) concentration.

To turn our attention to the concentration of plasma chloride: from the considerations given it is evident that not infrequently in the presence of upper intestinal obstruction the circumstances are such that the loss of chloride ion is not in excess or is only slightly in excess of the loss of fixed base, in terms of the plasma concentrations of these substances, with the result that plasma chloride remains at or only slightly below its usual value, although the absolute loss of chloride ion from the plasma and interstitial fluids may have been extremely large. To use a very simple illustration of the situation: if a large part of the contents of a flask of salt solution is poured out, the chloride concentration of the solution remaining in the flask is not altered. Even when the plasma chloride

is found greatly reduced, the extent of reduction of concentration is by no means a measure of chloride loss, since several times the total normal plasma content may have been withdrawn, as shown in the table. A point of great practical importance to be derived from these statements is that it is entirely incorrect to regard the plasma chloride concentration as an index of the degree of dehydration and of the extent to which replacement by salt solution is required.

From the foregoing discussion it is clear that the question of dehydration and the disturbance of the acid-base balance in the blood is intimately related to the loss of the digestive secretions by vomiting; and that the only way to correct these changes is by the administration of adequate volumes of fluid containing sodium and chloride. A further discussion of this will be found under "Treatment."

Changes in the Non-protein Nitrogen of the Blood. A marked increase in the non-protein nitrogen of the blood is frequently found following acute intestinal obstruction. It occurs even more consistently than does the lowering of the blood chlorides, for while the latter is not usually found in the fulminating cases of obstruction where strangulation is present and the disease runs too short a course for extensive vomiting to occur, an increase in the non-protein nitrogen of the blood is generally present.

Several factors may be responsible for the increase in non-protein nitrogen: in the first place, there is an increase in tissue destruction due to the effects of dehydration and perhaps in certain cases due to the action of some circulating toxin[21]; in the second place, dehydration brings about a decrease in kidney function (see p. 485), so that a heaping up of the non-protein nitrogen constituents of the blood takes place.

Other Findings in the Blood Chemistry. Other changes in the blood under conditions of obstruction have been recorded: large reductions in the oxygen content of venous blood; increased viscosity; increase in blood fibrin; and decrease in

sedimentation rate of erythrocytes have been found by Haden and Orr.[16,18,22,23] Ribeyrolles[24] has reported the occurrence of hemolysis following certain types of obstruction.

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TABLE XII

ESTIMATIONS OF LOSS OF WATER, FIXED BASE AND CHLORIDE ION FOLLOWING PYLORIC AND DUODENAL OBSTRUCTION, IN TERMS OF ORIGINAL BLOOD PLASMA CONTENT; DATA FROM RABBITS

	Pylorus Obstructed C.c.	Duodenum Obstructed C.c.
Water lost	203	235
Initial plasma H_2O	83	77
H_2O lost ÷ initial H_2O	2.4	3.1
	C.c. Tenth Normal	C.c. Tenth Normal
Fixed base lost	270	539
Initial plasma B	140	130
B lost ÷ initial B	1.9	4.1
Chloride lost	309	265
Initial plasma Cl	85	79
Cl lost ÷ initial C	3.6	3.4

It will be noted that several times the total initial plasma content of water, of fixed base and of chloride ion is lost during the survival period. These substances are largely replaced from the interstitial body fluids, with resulting dryness of the skin, shrinkage of the subcutaneous tissues and other clinical signs of dehydration. (Gamble and McIver[7])

Chapter XIV

THE CLINICAL AND PATHOLOGICAL PICTURE
(Continued)

Mechanism of Cardinal Symptoms

Pain. The three cardinal symptoms in cases of acute intestinal obstruction of mechanical origin are pain, vomiting and distention. Of these, abdominal pain is perhaps the most important; it is nearly always present and is usually severe. The character and localization of the pain in different types of obstruction are taken up in some detail under Diagnosis. In the present chapter will be considered some of the more fundamental questions dealing with the origin of pain and the pathways over which it is transmitted.

Mechanism of Sensation. The exact way in which sensations of pain from the intestinal tract are registered in consciousness has puzzled both physiologists and clinicians. Pain sensations are rarely (if ever) actually localized by the patient in the intestines but are referred to some portion of the anterior abdominal wall, and at times the skin in the region to which the pain is referred may become hypersensitive (cutaneous hyperalgesia) and the underlying muscle tonicly contracted (muscle spasm). The areas to which the pain is referred are fairly constant for certain portions of the intestinal tract; pain from the jejunum, for example, is referred to the midline above the umbilicus.[1] Presumably the particular locality to which the pain is referred depends upon the level at which the afferent impulses from the diseased viscus enter the spinal cord, the pain sensations being projected along the corresponding nerve roots to that portion of the abdominal wall which they supply.

Not only are pain sensations from a diseased intestine not localized in the intestine, but, somewhat paradoxically, in spite of the severe pain that is felt as a result of pathological

processes in the intestines, these viscera may be handled, pinched, cauterized or subjected to any of the other common types of stimulation without any resultant pain. It is well known that the parietal peritoneum, including the mesenteric attachment of the intestines, is extremely sensitive to the usual forms of stimulation; this, however, is readily explained, because sensory spinal nerves run in the loose connective tissue just beneath the layer of endothelial cells. Whether the mesentery also contains spinal sensory nerve endings is uncertain; but it has been suggested[2] that the pacinian corpuscles found in this region constitute such organs. It is generally agreed that the intestines themselves are supplied only by the vagus and splanchnic nerves. The disputed point, therefore, is whether or not there are direct pain sensations from the intestines, transmitted by afferent sympathetic fibers. Lennander[3] held that there were not: and attributed all sensations of pain either to a pull or to pressure exerted on the mesentery or parietal peritoneum by a violently contracting loop, or to an involvement of the mesentery or parietal peritoneum in an inflammatory reaction. Mackenzie[4] also did not believe that sensations of pain could come directly from abdominal viscera; he maintained that a portion of the spinal cord, upon receiving afferent impulses from a diseased viscus, became abnormally sensitive ("irritable focus"); and that normal sensory impulses from the muscles and skin entering this hypersensitive area were interpreted as pain which was localized, not in the viscus, but in peripheral structures (see Fig. 39). According to this view, pain from a duodenal ulcer, for example, is not felt in the duodenum but is referred to that part of the anterior abdominal wall corresponding to the distribution of the sensory nerves which have come from the segment of the spinal cord rendered irritable by afferent impulses from the diseased duodenum. Mackenzie's theory seems to have received some confirmation from the work of Weiss and Davis,[5] who were able to abolish certain types

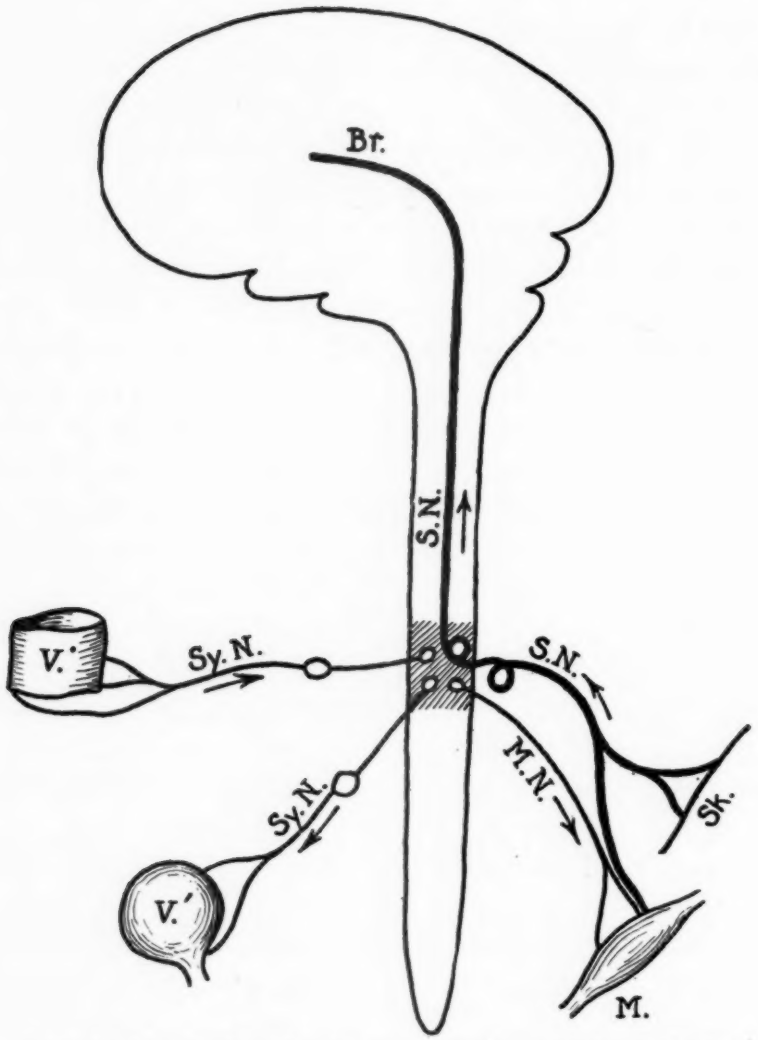

FIG. 39. Mechanism of visceral pain, cutaneous muscular hyperalgesia (viscerosensory reflex), the visceromotor reflex and organic reflex. An adequate stimulus proceeding from organ, V, by sympathetic nerve, SyN, to center in spinal cord extends to cells of nerves in its neighborhood, and stimulates them to activity, when function peculiar to each nerve is exhibited. Thus stimulus affecting cells of a pain nerve, SN, results in perception of pain which is referred by brain to peripheral distribution of nerve in external body wall (Sk, M); affecting cell of a motor nerve, MN, causes a contraction of muscle, M, supplied by motor nerve; and affecting cells supplying other viscera (as V') stimulates them to their peculiar function (as contraction of a hollow muscular viscus, or increased secretion of a secretory organ). If stimulus is of sufficient strength it may leave an irritable focus in spinal cord (shaded area) as shown by a persistent hyperalgesia of skin and muscle (Sk, M) and by a persistent contraction of muscle (M). (After Mackenzie[4])

of visceral pain by anesthetizing with a local anesthetic the area of skin to which the pain was referred.

On the other hand, Ross,[6] Nothnagel,[7] Hurst,[8] Ryle[9] and Morley[10] have contended that true pain sensations can arise from the viscera themselves, with appropriate stimulation. As regards pain from the intestines, the important factor, according to Hurst and Ryle, is abnormal tension in muscle fibers due to spasm or to failure to relax in the presence of increased intraintestinal pressure. Morley[10] regards intestinal pain as the result of increased tension on the sympathetic nerve endings in the intestinal musculature. That direct sensations of pain can arise from the intestines seems most likely, in view of the recent work of Mixter and White[11] and others, on sensations from the thoracic viscera conveyed by sympathetic fibers (see also Kuntz[12]). Ross, Hurst and Morley believe that there are two types of pain from the abdominal viscera; one direct from the viscera; the other referred. Head[13] agrees with this, and considers that the pain arising from the involved organ is "dull, boring and wearing," thus differing from the sharp aching and stabbing of referred pain. It seems probable that this view of two types of pain is correct; although there is no one theory that satisfactorily explains all the observed phenomena.

Alvarez's[14] article on abdominal pain reviews the literature on the pathways of pain and concludes that most of the sensory fibers leave by way of the splanchnic nerves, but points out that the situation is complex and that further study is required on many points.

It has been demonstrated both clinically and experimentally (Cannon and Murphy[15]) that acute intestinal obstruction is accompanied by a violent type of peristalsis, and it seems clear that part of the pain experienced is associated with this excessive intestinal activity; clinically it will occasionally be observed on inspection of the abdomen that the pain complained of is synchronous with a vigorous wave of peristalsis. The patient frequently recognizes this pain as

similar in character to former attacks of intestinal colic, such, for example, as results from the use of strong cathartics, or from eating the proverbial green apple, a type of pain undoubtedly associated with hyperstalsis and spasm. Hurst[8] believes that peristalsis itself is unable to cause pain: that only when the onward passage of intestinal contents is prevented by organic or spasmodic obstruction is there a rise of intestinal pressure sufficient to produce pain. It seems likely, however, that any violent, disordered type of peristalsis or a localized tonic contraction of a segment of intestine might give rise to painful sensations and that this type of pain is not a "referred" pain, but comes directly from the gut. The reference of these colicky pains is usually as follows: upper jejunal pain is apt to be referred to the mid-line between the umbilicus and the ensiform cartilage; sensations from the rest of the small intestine tend to be referred to the region of the umbilicus or across the abdomen above that point. Pain from the large intestine is usually referred across the abdomen below the umbilicus. (Fig. 40.)

There is probably another element present in the pain of intestinal obstruction, particularly in strangulations; although in such cases the very violent tonic contractions accompanying interference with the blood supply (Foster and Hausler,[17] McIver and others[18]) might, in part, account for the pain, there is probably also direct injury to the nerve endings in the mesentery. Not only does direct compression of the mesentery stimulate the nerve endings in this location, but edema and later inflammatory changes are also a source of irritation.*

Peritonitis is a third element that may play a role in the pain, particularly in strangulations and in the later stages of simple obstruction. Patients with this complication frequently show extreme localized tenderness and muscle spasm in the

* Brinton[19] considered that there was pain from congestion and dilatation of blood vessels in the region of the obstructing band; basing this chiefly on the fact that there were such a large number of nerve fibers accompanying the blood vessels to the abdominal viscera.

region overlying the strangulated loop, due to the involvement of the parietal peritoneum in the inflammatory process.

VOMITING. Vomiting is probably the next most important

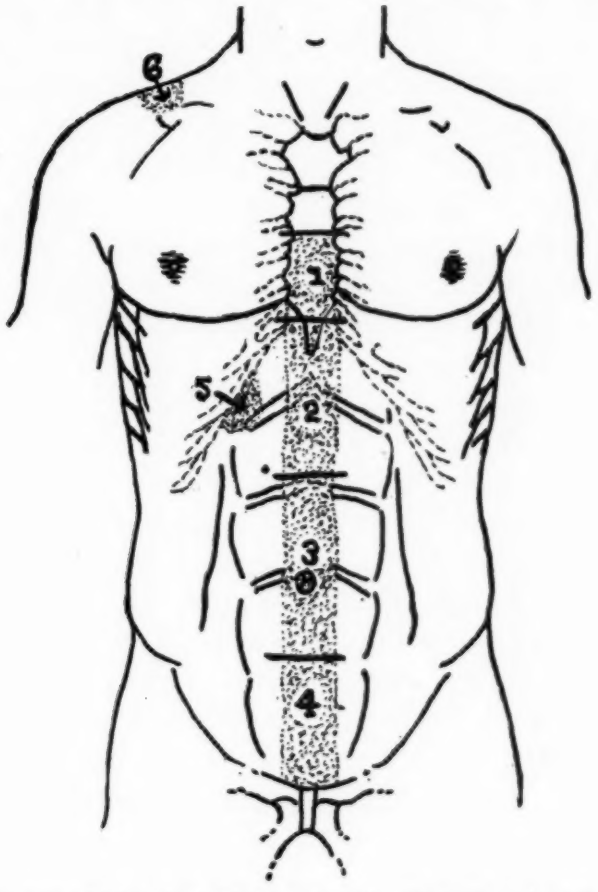

FIG. 40. Areas to which pain is likely to be referred from various parts of digestive tract: (1) from esophagus; (2) from stomach; (3) from small intestine; (4) from colon; (5) and (6), regions to which pain may be referred in diaphragmatic pleurisy; (5) from border of diaphragm, and (6) from its dome (according to Capps and Coleman). (Modified from Mackenzie,[4] by Homans[16])

symptom regularly associated with acute obstruction of the intestines. Since it occurs almost simultaneously with the onset of the attack, it must, at least in the early stages, be reflex in nature, as it is at the onset of most of the acute pathological conditions in the abdominal cavity. The stimulus reaches the vomiting-center, which according to Hatcher and Weiss[20]

is located in the medulla within the sensory nuclei of the vagi, by way of either the vagus or the splanchnic nerves. As the disease progresses the vomiting may be a manifestation of the general toxic state of the patient rather than a reflex phenomenon. In still later stages regurgitation from the stomach, rather than actual vomiting, often takes place; the dilated and atonic stomach never completely empties itself.

The mechanism by which the fluid that accumulates in the small intestine reaches the stomach has been a matter of some dispute. All the early writers regarded it as due unquestionably to reverse peristalsis; from the time of Galen[21] to the seventeenth century, reverse peristalsis was regarded as the essential feature in intestinal obstruction, indeed as the cause of "ileus" (Sydenham[22]*). Later Brinton[23] vigorously contested the idea that reverse peristalsis occurred. He believed that a normal wave of peristalsis passing along the intestine toward the occluded part tended to produce two distinct currents in the tube. One of these currents near the intestinal wall passed downward, carrying the contents of the bowel in the direction of the peristaltic wave; this increased the pressure in the bowel, and since a continued passage downward was prevented by the obstruction, an upward movement in the central part of the column of fluid occurred, and this upward current carried the liquid back into the stomach as succeeding waves of peristalsis passed downward toward the obstruction. Brinton compared this action to that of a hollow piston moving down a tube which is closed at one end; as the piston moves downward, fluid is

* The following quotation is from Sydenham: "This terrible disorder (ileac passion), which has hitherto generally been esteem'd fatal, is owing to the inversion of the peristaltic motion of the guts, when their contents are forced upwards, and thrown out by vomiting, so that the strongest glysters become emetic, as do likewise cathartics, immediately after being taken. And I judge the exquisite and intolerable pain attending this disorder, proceeds only from the inverted peristaltic motion of the bowels, whose natural formation is such as by their many folds to promote the descent of the faeces in the properest manner; and therefore whenever they are forced to yield to a motion opposite to that of their fibres, a pungent pain is occasioned."

Sydenham considered that in organic obstruction reverse peristalsis occurred above the obstruction only. He therefore called it "spurious ileac passion."

forced up through the hole in the piston. More recent studies have shown that both Brinton and the very early writers are correct. Cannon and Murphy[15] were able by means of the fluoroscope to see the intestinal contents "squirted" backward towards the stomach when a powerful wave of peristalsis passed downward toward the obstruction. These authors, however, further demonstrated that at times a true reverse peristalsis also occurs. (See also Alvarez[24,25].)

Another belief was held by Nothnagel,[26] who regarded the act of vomiting as a force capable in itself of carrying the intestinal contents upward to the stomach. The occluded bowel, he considered, became dilated with fluid above the obstruction, the column of fluid extending backward to the stomach; when the act of vomiting occurred the diaphragm and abdominal muscles contracted, the intra-abdominal space was reduced, pressure was exerted on the intestine with its contained fluid, and since the pressure could not be relieved by forcing the fluid downward, it was of necessity forced upward, into the stomach. Some such mechanism may occur in the late stages, for at that time probably all types of peristalsis are absent and yet profuse vomiting, or at least regurgitation, may continue to the end.

While the loss of fluids with the contained sodium and chloride ions is, of course, detrimental to the body as a whole, the drainage back into the stomach and vomiting must be a beneficial compensatory phenomenon relieving intraintestinal pressure and so conserving the circulation in the bowel wall. It is possible that in humans the ligament of Treitz and the sharp angulations of the duodenum tend to prevent a perfectly free flow backward into the stomach and perhaps this is one reason why the insertion of a catheter into the jejunum at times gives such beneficial results.

Distention. A third symptom frequently encountered in patients with intestinal obstruction is abdominal distention. Distention is brought about by an increased pressure of either

fluid or gas or of both together in the intestinal lumen. We will first consider the intestinal fluids, their source and character.

Source and Character of Distending Fluids. The fluid that accumulates in such large amounts above an obstruction has certain typical characteristics. It is the same foul-smelling, yellowish fluid with white flecks of particulate matter that is described under "fecal vomiting." It is derived from several sources. In the first place, there is the fluid that reaches the intestines from the stomach, consisting of ingested fluids, saliva and gastric secretions. To this is added, in the upper duodenum, the secretions from the liver and the pancreas; and finally there is abundant outpouring from the intestines themselves. Most of the increased secretion is probably best regarded as the result of an irritative process. That injury or irritation of the nerve endings in the intestinal walls may be an important factor is suggested by the fact that cutting the nerves to an intestinal loop is capable of producing copious secretion, the so-called "paralytic secretion" (Mendel,[27] Falloise,[28] Molnar[29]). Perhaps some rôle may be played by an increase in the osmotic pressure of the loop contents. Boese and Heyrowsky[30] considered on the basis of their animal experiments that in obstructions of the colon a hypersecretion of the mucous glands and a transudate due to injury of the mucosa and blood vessels occurred. Dragstedt[31] has suggested that certain products of decomposition formed in the obstructed loop may, when absorbed, act as secretagogues and further augment the secretion from the digestive glands and intestines. Where there is blockage of the venous mesenteric circulation, such as is found in strangulation, the obstructed loop becomes distended by a bloody fluid exudate brought on by an increase in the capillary pressure and by damage caused by a poor supply of oxygen[32]; the particulate matter, which consists chiefly of blood cells and bacteria, may constitute 40 per cent of the fluid in these cases of strangulation (McIver, White and Lawson[18]). The early experiments of Kader,[33] dealing with the characteristics of distention

following various types of strangulation and interference with the mesenteric blood supply, are of interest.

Not only is there a great outpouring of fluid into the intestine under conditions of obstruction, but there is a retardation of absorption which further favors the onset of distention.

Source and Character of Distending Gases. An increased volume of gas in the intestinal lumen may at times be a very important factor in the production of distention.

The gases of the intestinal tract were first systematically studied by Planer[34] in 1860 and the work later amplified by Ruge,[35] Tappeiner,[36] Tacke[37] and others. These writers agree that the gases commonly present in intestinal meteorism are carbon dioxide, oxygen, nitrogen, methane, and sometimes hydrogen sulphide, the proportions being subject to considerable variation. In considering the relation of these gases to distention, their origin must be taken into account.

One well-recognized and important source for certain of the gases is found in the decomposition of intestinal contents; this is probably one of the most important causes of gaseous distention under conditions of mechanical obstruction; corroboration is found in the fact that obstructions of the large intestine, where fermentation is active, are usually characterized by marked gaseous distention. The amount of gas in the obstructed small intestine probably depends to some degree on whether the intestine was empty at the time the obstruction occurred; or, if not, to what stage digestion had proceeded, since the presence of partially digested food of course greatly increases the likelihood of active fermentation and gas formation. The work of early German writers, already mentioned, and more recent studies by Boycott and Damant,[38] furnish data on this subject and emphasize the influence of different types of diet on the kind of gas produced.

A second source for the distending gases is found in the diffusion of the blood gases into the intestinal lumen. The walls of the intestine are permeable to gases and an active interchange takes place, tending to keep the gases on the two sides

of the intestinal mucosa in equilibrium. The mechanism of this exchange is discussed in detail in a report by McIver, Redfield and Benedict.[32] (See Fig. 41.)

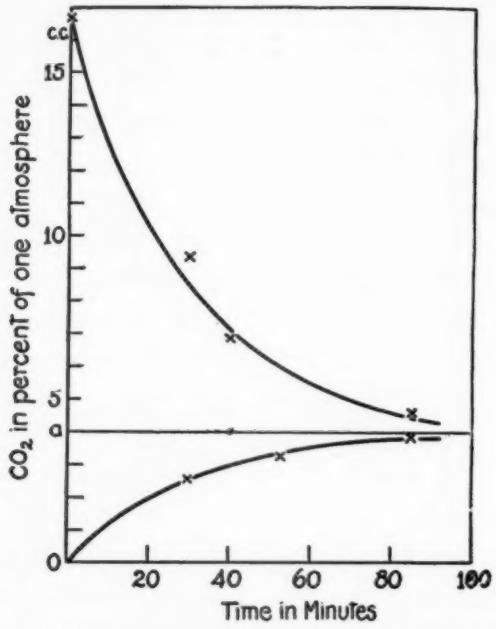

FIG. 41. When air is injected into stomach, CO_2 enters until concentration equals that of blood. Crosses related to lower curve show rate at which this proceeds. When air containing a high percentage of CO_2 is injected into stomach, CO_2 diffuses out of stomach into blood. Crosses along upper curve show rate at which this process goes on. Crosses represent actual measurements; curves are calculated on assumption that CO_2 is passing by diffusion and not by secretion. Close agreement between crosses and curves suggests that CO_2 enters and leaves stomach by process of diffusion. Line *a* represents concentration of CO_2 in blood. (McIver, Redfield and Benedict[32])

A third source for the intestinal gases found in distention must be considered. The gas normally found in the stomach consists primarily of atmospheric air admitted by swallowing. Under certain conditions the amount of air is considerably increased[39,40]; and the experiments of McIver et al.[39] showed that accumulations of air in the stomach are readily carried into the intestines and that in certain of the functional obstructions, particularly those following peritonitis or operative trauma, this may be an important factor in the production of distention. Considerable quantities of air were found by

these authors in the stomach of patients following operation; and the removal of this air at frequent intervals during the first twenty-four to forty-eight hours following operation markedly

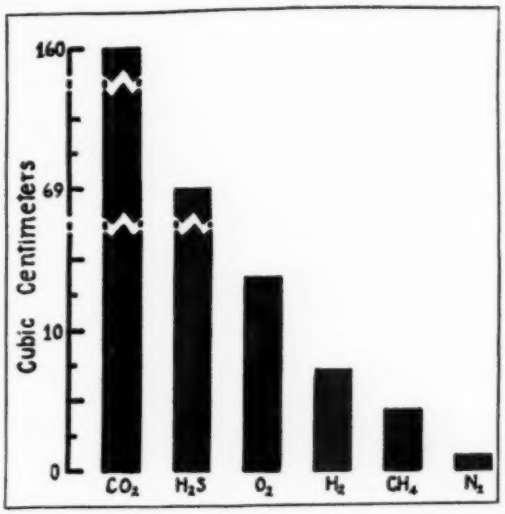

FIG. 42. Relative rates of absorption, expressed in cubic centimeters, of carbon dioxide, hydrogen sulphide, oxygen, hydrogen, methane and nitrogen, from a 25 cm. loop of small intestine of cat. Height of columns represents number of cubic centimeters of gas absorbed over a period of one hour. In case of carbon dioxide, because of rapidity of its disappearance, and of hydrogen sulphide, because of its toxicity, gas was withdrawn after lapse of a few minutes, and rate of absorption for one hour was calculated. Rate of absorption of atmospheric air was also tested in these experiments, although results are not shown in this diagram, and was found to be low, only 4 c.c. being absorbed from a 45 cm. loop in five hours. This is to be expected, because of close similarity (except for content of CO_2) between composition of atmospheric air and that of blood gases. (McIver, Benedict and Cline[39])

decreased the incidence of postoperative distention. Experiments also showed that air injected into the stomach of animals was often passed downward into the intestine; and that animals with peritonitis in which the pylorus was ligated so that air could not be passed into the intestines, showed a dilatation of the stomach but no distention of the intestines, while animals in which the pylorus was not ligated showed dilatation of both stomach and intestines.

The Body's Methods of Eliminating Intestinal Gas. The expulsion of gas by motor activity of the intestine is an important method of eliminating abnormal accumulations. Since,

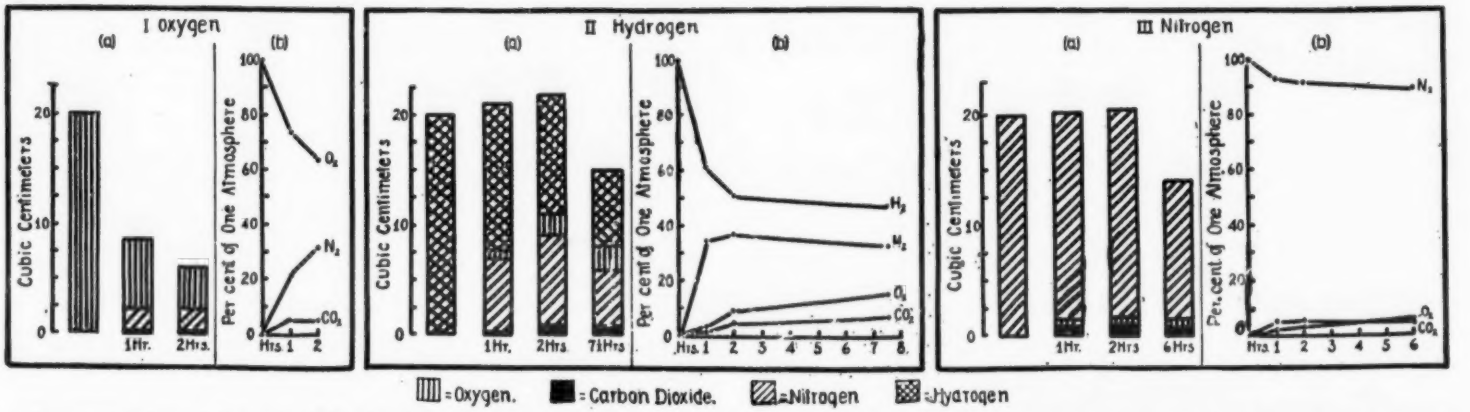

FIG. 43. Course of events following introduction of (I) O_2, (II) H_2 and (III) N_2 into an isolated loop of small intestine. Gases were injected severally, allowed to remain for period of time indicated, drawn off and analyzed. First column in diagram (a) represents in cubic centimeters volume of gas injected; succeeding columns represent total volume of gas and its composition when withdrawn from intestinal loop after stated intervals of time. Percentage results of analyses are plotted in diagram (b). Line descending from upper left indicates, in percentage, absorption of injected gas. Lines ascending from lower left indicate entrance of blood gases. (McIver, Redfield and Benedict[32])

however, the gases cannot be driven by peristalsis beyond the point of intestinal obstruction, a second method must be relied on, namely, absorption into the blood stream.

The diffusion of blood gases into the intestinal lumen was mentioned in a preceding paragraph: the reverse process, namely absorption of gases from the intestine into the blood and elimination through the lungs, is, under normal conditions, equally active. The importance of this mechanism of elimination of gases is illustrated by Figures 42 and 43; particular attention is called to the first column of Figure 42, which shows the normal rapid absorption rate of CO_2.

If, under conditions of obstruction, gas accumulates in the intestines faster than it can be eliminated by absorption into the blood stream, distention ensues. As the distention increases, the circulation to the bowel wall is interrupted, so that the absorption of gas is still more diminished; this, in turn, causes further distention, and a vicious circle is instituted. Impaired absorption is particularly serious in the case of CO_2 for this gas is given off in large volumes during fermentation, and under normal conditions would be rapidly absorbed by the blood stream.

When sudden gross interference with the mesenteric circulation occurs, experiments have shown[32] that if the loop is empty of gas at the time of the blockage of the mesenteric circulation, the thick, bloody exudate previously described occurs promptly, but there is usually very little accumulation of gas; if, on the other hand, the intestinal loop contains some gas at the time of the venous obstruction, the volume of gas increases, due chiefly to an accumulation of CO_2.

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[The Remainder of the References to Chapter XIV will appear in a later issue.]

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